ABSTRACT

Title of Dissertation:	THE IMPACT OF AGE COMPOSITION IN EXPLAINING THE INTERNATIONAL HOMICIDE DECLINE – A SEVEN-DECADE LONGITUDINAL STUDY
	Mateus Rennó Santos, Doctor of Philosophy, 2019
Dissertation directed by:	Professor, James Lynch, Department of Criminology and Criminal Justice

Since 1991 the homicide rate of the United States declined by more than 40%. Such a dramatic change in the crime rate of any country, particularly one of the size of the United States, is highly unusual. Numerous studies have proposed explanations for this event, yet experts agree that the causes of the homicide decline are still a mystery.

Recent comparative research found that many countries worldwide experienced very similar homicide declines as the United States', suggesting that the homicide decline was actually an international event. This finding has several implications for the study of crime trends. In particular, it shifts the search of causes from domestic policies, to shared international phenomena.

This study tests whether changes in the relative size of countries' youth populations,

an event that is occurring globally, explain international homicide trends since 1960, including the international homicide decline of more recent decades.

While strong theories exist predicting a relationship between age composition and homicide trends, empirical studies on the topic have consistently found a null association between the two variables. This dissertation contextualizes that literature, discussing how its shortcomings may have artificially created a contradiction between the expected and the observed effect of age composition on homicide trends.

To investigate this topic, this study makes use of a novel dataset on international homicides from the United Nations Office on Drugs and Crime, spanning the previous seven decades. These data were combined to other sources to provide evidence that changes in the homicide rates of countries are largely driven by the size of their youth population, and that the international homicide decline has been a consequence of a global process of population aging. Moreover, by showing that the effect of age composition is most visible at the safest countries of the world – in the absence of competing criminogenic forces driving the homicide trend – this study also explains why the most violent countries are failing to accrue the safety benefits of the aging of their populations, and are not themselves experiencing homicide declines.

THE IMPACT OF AGE COMPOSITION IN EXPLAINING THE INTERNATIONAL HOMICIDE DECLINE – A SEVEN-DECADE LONGITUDINAL STUDY

by

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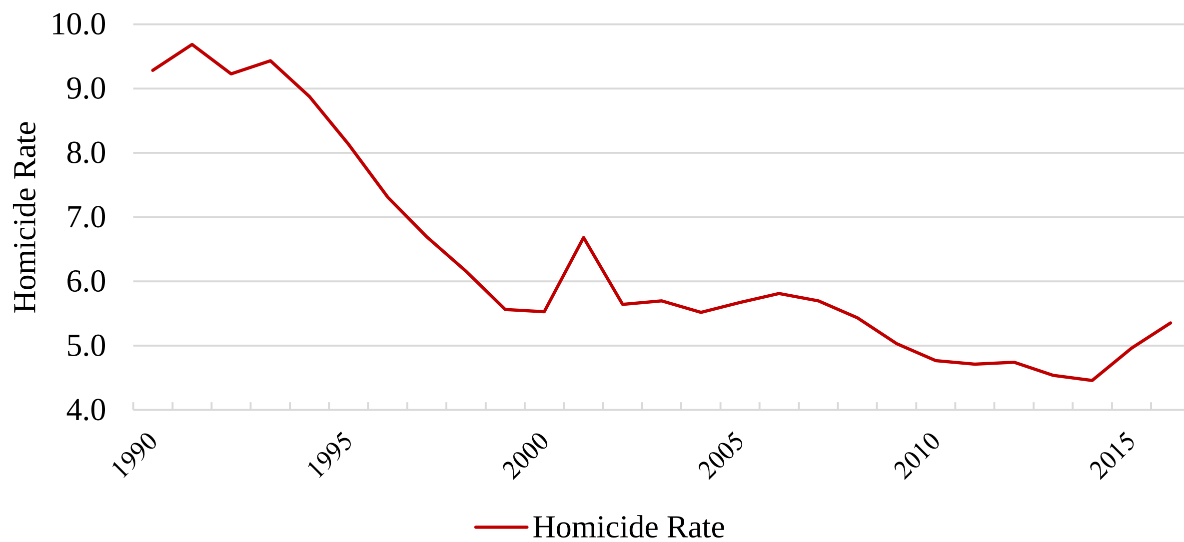
Chapter 1: Introduction

While wars get much attention for their atrocity, homicides are actually the cause of a much greater number of killings. Combined, all of the world's wars and conflicts are estimated to have been the cause of around 66,700 deaths in 2015 (Melander, 2015) while, according to estimates of the current study, there were 360,000 homicides globally during the same year. In the past 10 years, more people died from homicides globally than the population of Connecticut, and that of 21 other American states (United States Census Bureau, 2018). However, despite the tremendous loss caused by homicides, social scientists still lack a comprehensive understanding for the causes of changes in homicide rates over time (Baumer et al., 2018; Rosenfeld, 2018).

In the United States alone, more than one million lives were lost to homicide since the 1950s (World Health Organization, 2018). Moreover, the homicide rate of the United States is considerably higher than of other developed democracies around the world. In 2015, the homicide rate of the United States, at 4.96 per 100,000 individuals, was more than three times greater than the rate of Finland (at 1.5 per 100,000), and almost six times the rate of countries such as Greece, Germany, or Italy.

The United States homicide rate also had considerable changes over time. In 1960, the U.S. homicide rate per 100,000 population was 4.5, from which point it increased two-fold up until a peak of 10.3 per 100,000, in 1991. From that peak, however, homicides started a decline that lasted until 2002, when the rate stabilized at around 5.6 per 100,000 population. That decline in homicides corresponded to a drop of 46% in less than 10 years. The 1990's crime drop is observable across multiple data sources (e.g. police records, self-report victimization) and was shared with other types of violent crime (Blumstein & Wallman, 2006). Figure 1.1 presents the United States homicide trend from 1990 to 2016, using data from the United Nations Office on Drugs and Crime, which is described in Chapter 4.

Figure 1.1: The United States Homicide Decline – 1990 to 2016



Source: United Nations Office on Drugs and Crime

The 1990's homicide decline is one of the most relevant social events in the last few decades. Indeed, it is very rare that the homicide rate (or any other macro-level indicator) of a country changes so dramatically in a period shorter than a decade. Perhaps for that reason, the homicide decline was largely a surprise for social scientists, some of whom actually predicted even greater rates of violence during the early 1990s, supposedly caused by the aging of a generation of "super-predators" (Dilulio, 1995). Moreover, there is still little consensus in criminology about the causes of the 1990's homicide decline.

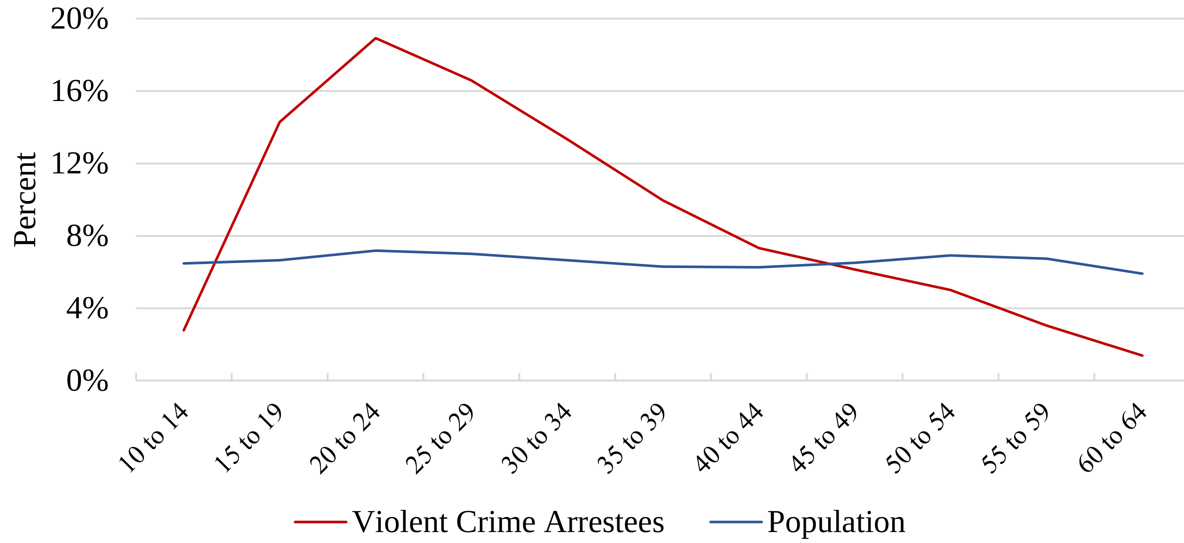
Identifying the causes of changes in social phenomena is a very challenging task and a subject of much debate across the social sciences. Societies are extremely dynamic entities. At any given time, there are numerous events and social forces in play, each with its own effects and interactions. Hence, it is very difficult to isolate the impact of any single event or social force from everything else happening at the same time. Consequently, there are several divergent explanations for the 1990’s crime drop. Blumstein and Wallman’s (2006) book on the topic mentions a combination of causes, discussing the impact of gun laws, mass incarceration, the receding crack market, innovations in policing, improvements in the economy, and demographics. A highly cited paper by Levitt (2004) reviews ten purported causes for the crime drop, finding significant impacts for the increase in the number of police, the increases in incarceration, the receding crack market, and the legalization of abortion. More recently, a report by the Brennan Center for Justice (Roeder et al., 2016) argued for the impact of an increase in real income, coupled with data-driven improvements in policing, and the aging of the population.

Several studies about the 1990’s crime drop attribute at least some of the decline to changes in the age structure of the population as Americans were getting proportionally older during the 1990s. However, recent criminological literature about the 1990’s crime drop, and about crime trends in general, argues for “the limited role of changing age structure in explaining aggregate crime rates” (Levitt, 1999), in favor of alternative causes (Steffensmeier & Harer, 1999, Blumstein et al., 2000; Cook & Laub, 2002; Phillips, 2006).[1]

The findings from these studies are surprising. At the individual level, age is one of the strongest correlates of offending and of victimization (Farrington, 1986; Hirschi & Gottfredson, 1983; Miethe & Meier, 1994). The age-crime curve describes a highly uneven distribution of crime involvement by age, sharply increasing from the end of childhood until a young-adulthood peak, from which point individuals progressively age out of crime. In the United States in 2015, individuals aged 15 to 29 corresponded to 20% of the population, but were responsible for 50% of all arrests for violent crimes (Federal Bureau of Investigation, 2015).

[1] Interestingly, Dilulio (1995) partially based his forecast on the effect of age composition, as he argued that there would an increase in the number of youth between the ages of 14 and 17, of whom 6% would become chronic violent offenders.

Figure 1.2: Distribution of Violent Crime Arrestees and Population by Age Group – United States, 2015



Source: Federal Bureau of Investigation (US) / World Population Prospects (UN)

A macro-level association between age composition and homicide rates cannot be automatically inferred from an individual relationship between age and criminality, under the risk of an atomistic fallacy. However, unless due to the interference of some unknown social mechanism, the consistency of the relationship between age and criminality should have macro-level repercussions. In addition, strong theories exist predicting an association between a greater proportion of younger individuals and higher crime rates (which are reviewed in Chapter 2), while there is not yet a compelling explanation for the absence of a macro-level relationship between age composition and homicide rates.

I argue that this contradiction between the expected and observed effect of age composition on homicide rates is a consequence of limitations in previous research on crime trends. First, research usually uses data from a small number of years, which may be inadequate to observe the influence of broader social and economic processes that can take decades to unfold. Second, quantitative social research often places too much focus on average effects, perhaps overlooking important nuances. Finally, I argue that factors that explain the differences in homicide rates between countries may be different from the causes of changes within countries – a distinction that, I argue, should be better accommodated in crime trends research. I elaborate on each of these points in Chapter 3.

Age and the United States 1990's Homicide Decline

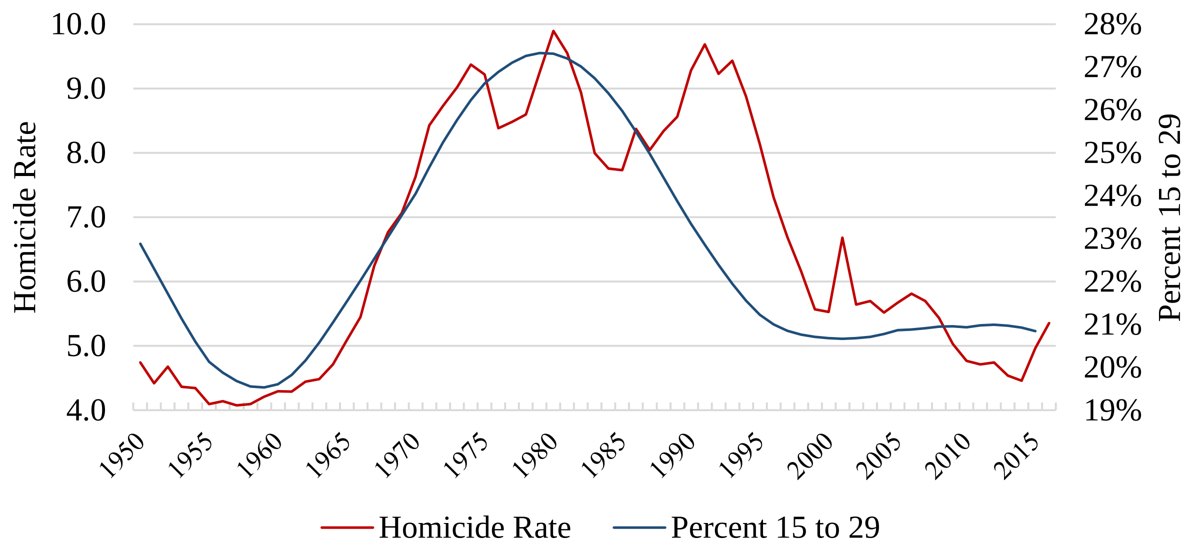
The following graphs compare homicide rates with the proportion of the population between 15 and 29 years of age in several individual countries from 1950 to 2016. The age range between 15 to 29 years of age includes the ages most prone to violent criminality in the United States, and that age range is very frequently used in criminological research to measure of size of the youth population (Cole & Gramajo, 2009; Gartner, 1990; Lee, 2001; Neapolitan, 1997; Trent & Pridemore, 2012).[2] Subsequent analyses also explore the use of other measures of age composition which have been employed by extant research, in particular the percent of the population between 15 to 24 years of age, and the percent of individuals who are males and between 15 to 29 years of age (Rogers & Pridemore, 2017; Trent & Pridemore, 2012), finding no substantial differences.[3]

[2] A detailed discussion about the motivations for the use of the ages between 15 and 29 years, as opposed to other age ranges is included in Chapter 4.

[3] While it is not the central focus of this study to investigate the effect of sex composition on homicide trends (e.g. the percent of males), it should be noted that a developing literature exists on that topic (Blumstein & Wallman, 2006; Deane, 1987;

Figure 1.3 uses data developed for the current project, which corresponds to a combination of the United Nations Homicide Statistics with the World Health Organization Mortality Database. The figure presents the trends in percent youth and in homicide rates for the United States between 1950 and 2016. Population by age group was collected from the United Nations. Data and methods are described in Chapter 4.

Figure 1.3: Homicide Rate and Percent of Population 15 to 29 – United States, 1950 to 2016



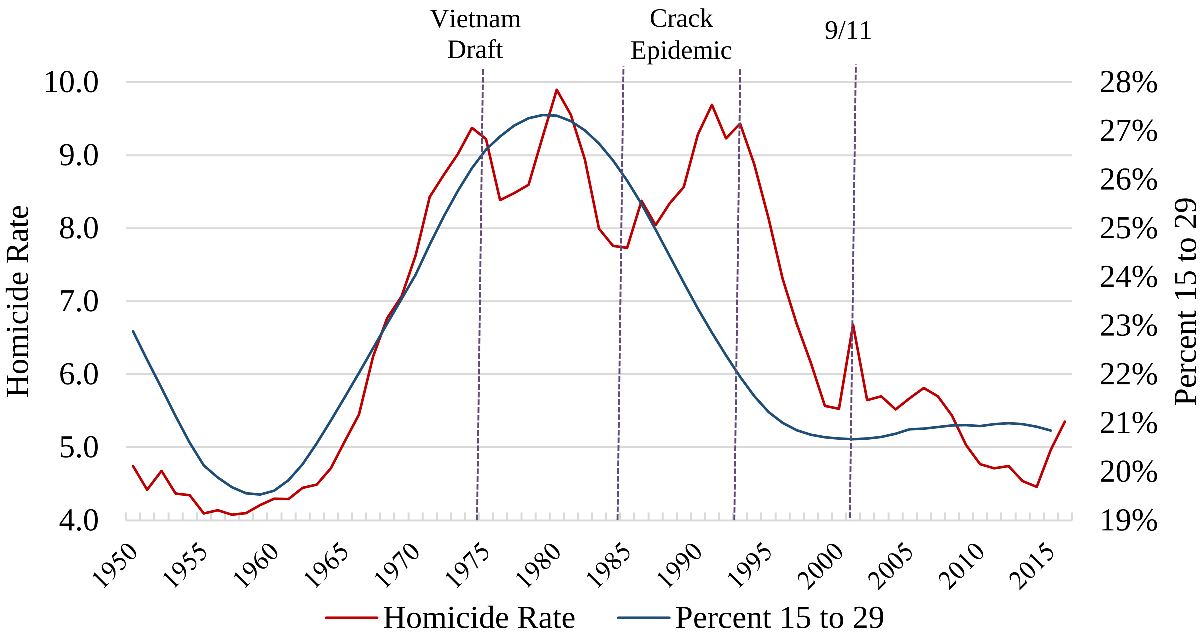
Source: United Nations Office on Drugs and Crime / World Health Organization / World Population Prospects (UN)

Messner & Sampson, 1991). Generally, the literature suggests that, contrary to expectation, a smaller proportion of males is not associated with lower homicide rates, and is instead indicative of an imbalance in a society, which may be a consequence of conflict or some other source of social disruption (Hesketh & Xing, 2006; Pridemore, 2008; Trent & Pridemore, 2012). More specifically, a decrease in the proportion of males in a country is indicative that these individuals are dying at a young age because of violence of another external cause.

The figure shows the impact of an aging cohort of post-World War II baby-boomers on the percent of the population between 15 and 29 years of age, which peaked at over 27% in 1980. During the 1960s and 1970s there is a clear association between that proportion and the increase in homicides of the period, a relationship which was noted by criminological research in subsequent decades (Cohen & Land, 1987; Wellford, 1973). A slight decline in homicides during the 1970s was possibly related to the Vietnam War, which ended in 1975. More than 2.7 million Americans served in the war, mostly young men close to the peak of the age and crime curve, but who were fighting abroad and unable to attribute to the domestic homicide rate. Moreover, during the war the United States suffered around 58,000 casualties, and 75,000 severe disabilities (National Archives, 2018). In effect, wars can change the age composition of populations.

The graph also shows a decline in homicide rates beginning in 1980, which follows a trend of a decreasing youth population, but which was interrupted in 1985 by a crime spike that lasted until 1991. This was the era of the war on drugs and of tough on crime policies that profoundly changed the American criminal justice system. This was also the time of the crack epidemic, and the corresponding escalation of violence among youth in the inner cities (Blumstein, 1995). However, in 1992 homicide trends resumed their decline, returning to a strong relationship with age composition which was simply interrupted by the crack epidemic.

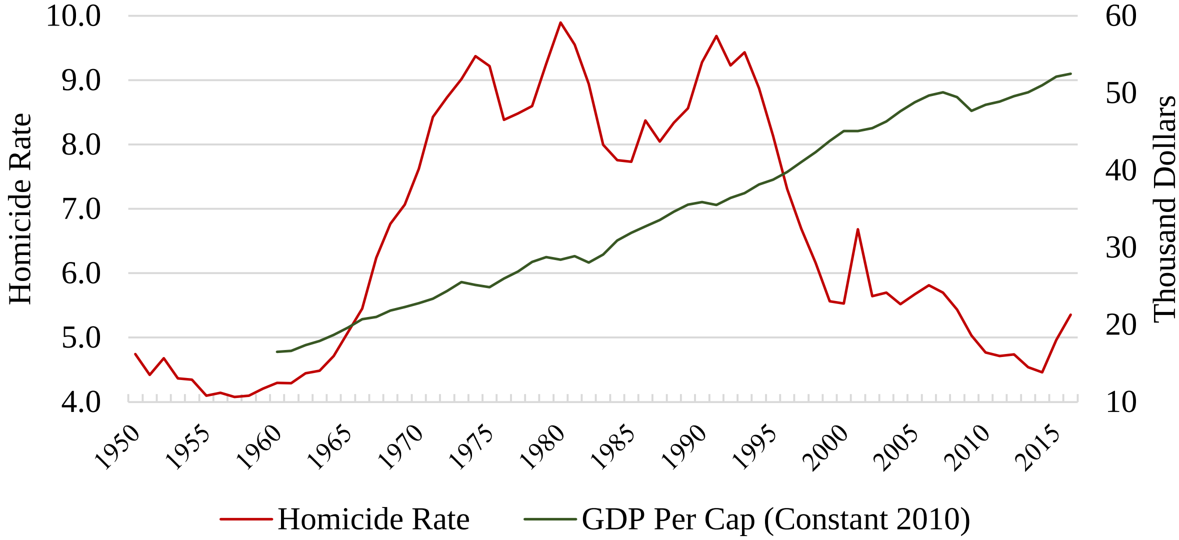
Figure 1.4: Selected Period Effects and the United States Homicide Trend – 1950 to 2016



Source: United Nations Office on Drugs and Crime / World Health Organization / World Population Prospects (UN)

Alternative explanations for changes in homicide rates in the United States are often able to display a bivariate association with the 1990's homicide decline, but they often are not able to account for other longer-term features of the homicide series, such as the 1960's increase. While the current study does not attempt to test or to disprove alternative explanations for the 1990's homicide decline, the following two figures highlight the benefits of a longer-term perspective in evaluating drivers of homicide trends. Figure 1.5 addresses the proposition that the homicide decline was driven by an improving economic outlook during the 1990s (Blumstein & Wallman, 2006; Gerdtham & Ruhm, 2006; Gould et al., 2002). Data on the Gross Domestic Product (GDP) per capita, an aggregated measure of a countries' wealth, was obtained from the World Bank Open Data (2018). Values are in constant 2010 US$, which accounts for inflation.

Figure 1.5: Homicide Rate and GDP Per Capita – United States, 1950 to 2016

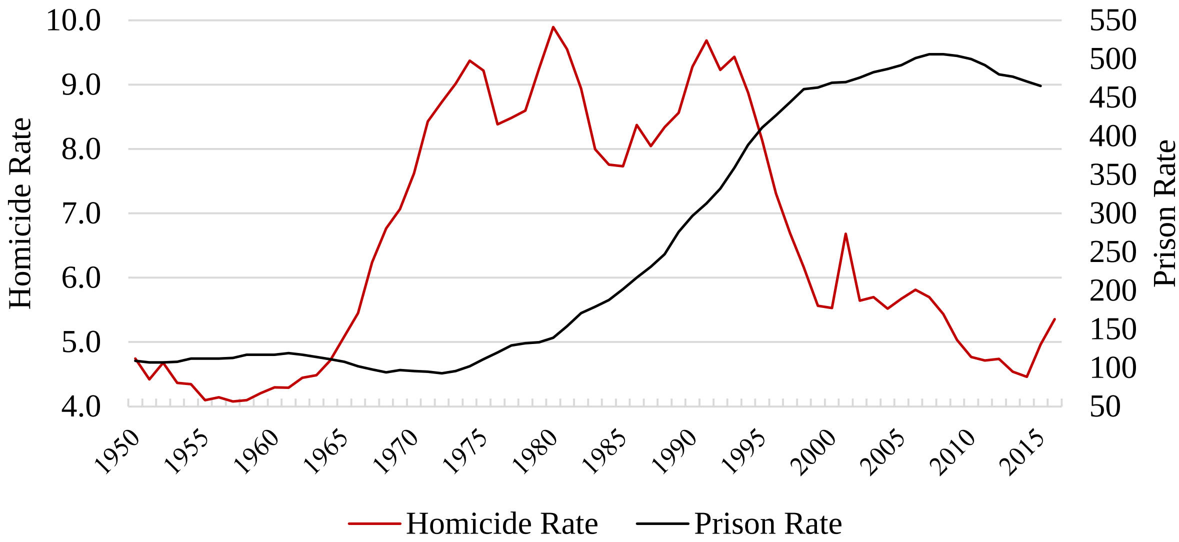


Source: United Nations Office on Drugs and Crime / World Health Organization / World Bank

As the figure shows, one of the most remarkable features of the United States economy is its ability to produce increased value over time, at an almost constant rate through more than five decades since 1960. The homicide trend appears to be irresponsive to the trend in GDP per capita. Even the economic downturn between 2008 and 2009, the most notable break in the generally improving economic outlook of the United States, actually happened at the same time as a decline in the homicide rate of 0.4 per 100,000 population.

Figure 1.6 address the proposition that the United States homicide decline could have been driven by an increase in incarceration rates during the 1990s (Blumstein & Rosenfeld, 1997). The following figure replaces the GDP per capita with the number of prison inmates per 100,000 population. Historical data on the prison population excludes jail inmates, and was obtained from the National Prisoner Statistics (NPS) Program of the Bureau of Justice Statistics (2018).

Figure 1.6: Homicide Rate and Prison Rate – United States, 1950 to 2016



Source: United Nations Office on Drugs and Crime / Would Health Organization / National Prisoner Statistics (US)

While homicides where doubling during the 1960s, the prison rate was stable. Between 1985 and 1991 the homicide rate increased by 32%, while the incarceration population increased by 55%. The 1990s was one of the few periods of all 66 years during which the prison population trend and the homicide trend displayed a negative association.

An analysis that selectively encompassed only data since 1990 would find a negative bivariate association between homicide rates and GDP per capita, and between homicide rates and the prison rate. A longer-term perspective however, illustrates that these associations are highly dependent on the years of data used to evaluate them. In contrast, the percent youth series maintains a strong association with the homicide trend in the United States since the 1950s, including during times of increases in the homicide rates (as observed during the 1960s), and during the 1990's homicide decline.

Age and the International Homicide Decline

Similar to mass incarceration, most explanations for the 1990's crime drop are about domestic policies and events specific to the United States. As such, the outcome of these policies in terms of lower levels of crime should also be limited to the United States' borders. However, research comparing the crime trends across countries has consistently presented evidence that the 1990's crime decline was also experienced by several other countries around the world (Farrell et al., 2014; Rennó Santos & Testa, 2018; Sidebottom et al., 2018; Tilley et al., 2018). A comparison between Canada and the United States over the past century shows that homicide rates in these countries closely follow each other, including with regard to the 1990's decline (Ouimet, 2002; Zimring, 2006). However, Canada did not have a drastic increase in incarcerations, did not increase their police force, nor the aggressiveness of its police tactics. A cross-national study using data on wealthy countries from the International Crime Victims Survey (ICVS) compared rates of theft, burglary, and assault from cities within 26 countries across the developed world, finding evidence of a global crime drop, which was experienced in several countries throughout the 1990s and into the 21st century (Tseloni et al., 2010). Other studies have also found that the 1990's homicide decline was shared by several western, wealthy democracies with available data (LaFree et al., 2015; Weiss et al., 2016; Rennó Santos & Testa, 2018). Therefore, the homicide decline was actually an international event.

Very few of the explanations for the United States homicide rate decline are applicable internationally. Like Canada, most other countries do not share the same criminal justice policies as the United States, nor have they experienced the same changes in policy over the past three decades. What they do share, however, are changes in the age structure of their populations.

There is a strong, global trend of population aging (Kinsella & Phillips, 2005). Immediately following the end of World War II, much of the world experienced a sudden increase in fertility rates (i.e. the average number of children per women), leading to a spike in proportion of adolescents and young adults in the ensuing decades. At the same time, improving hygiene standards, coupled with developments in health care since 1950 increased the global life expectancy by more than 20 years, increasing the average age of populations globally, while decreasing the proportion of youth relative to total population sizes (He et al., 2016; United Nations, 2013).

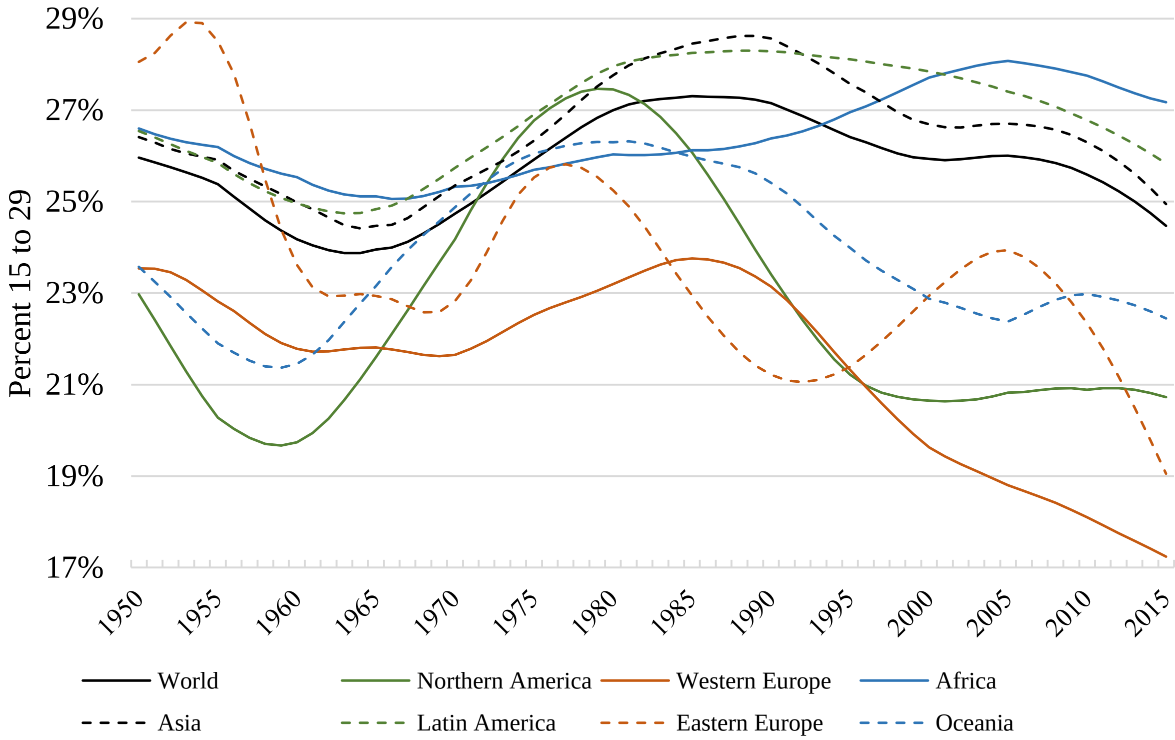
At the same time, lower levels of mortality at the youngest age groups increased the proportion of newborns able to survive into adulthood. This increase in survival is a key turning point in populations, as it triggers a well-known demographic phenomenon called the Demographic Transition (Coale, 1989; Kirk, 1996). In 1950, a woman had an average of five children (United Nations, 2013). Such a high rate did not translate into population growth, because many of these children died before having their own children. As mortality rates declined, and as women maintained high fertility rates, societies experienced a spike in population growth. Over time, however, reproductive patterns changed and families adjusted from having a high, to a low number of children. Particularly in developing countries, sudden Demographic Transitions generated disproportionally large cohorts, which aged though the second half of the 20th century.

In a third demographic process, several developed countries are recently experiencing changes in family formation and in reproductive preferences, which may be triggering what has been defined as the Second Demographic Transition (Van de Kaa, 1987). In these countries, individuals are increasingly delaying, or completely avoiding parenthood (Lesthaeghe, 2010). Consequently, countries worldwide are experiencing sharp declines in fertility, sometimes to numbers below replacement level fertility, which is the level necessary to replace previous generations and to maintain the population size (United Nations Population Division, 2018).

Together, these processes have produced substantial shifts in the participation of younger individuals in the demographic composition of populations worldwide, relative to the elderly. The following figure is based on country-level data on population by age group from the World Population Prospects of the United Nations (2018). This source is described in Chapter 4. The figure displays trends for the world and by region in the percent of the population between 15 and 29 years.[4]

[4] Countries included in each region are listed in Appendix B and Appendix C.

Figure 1.7: Percent of the Population between 15 and 29 years by Region and Year – 1950 to 2015

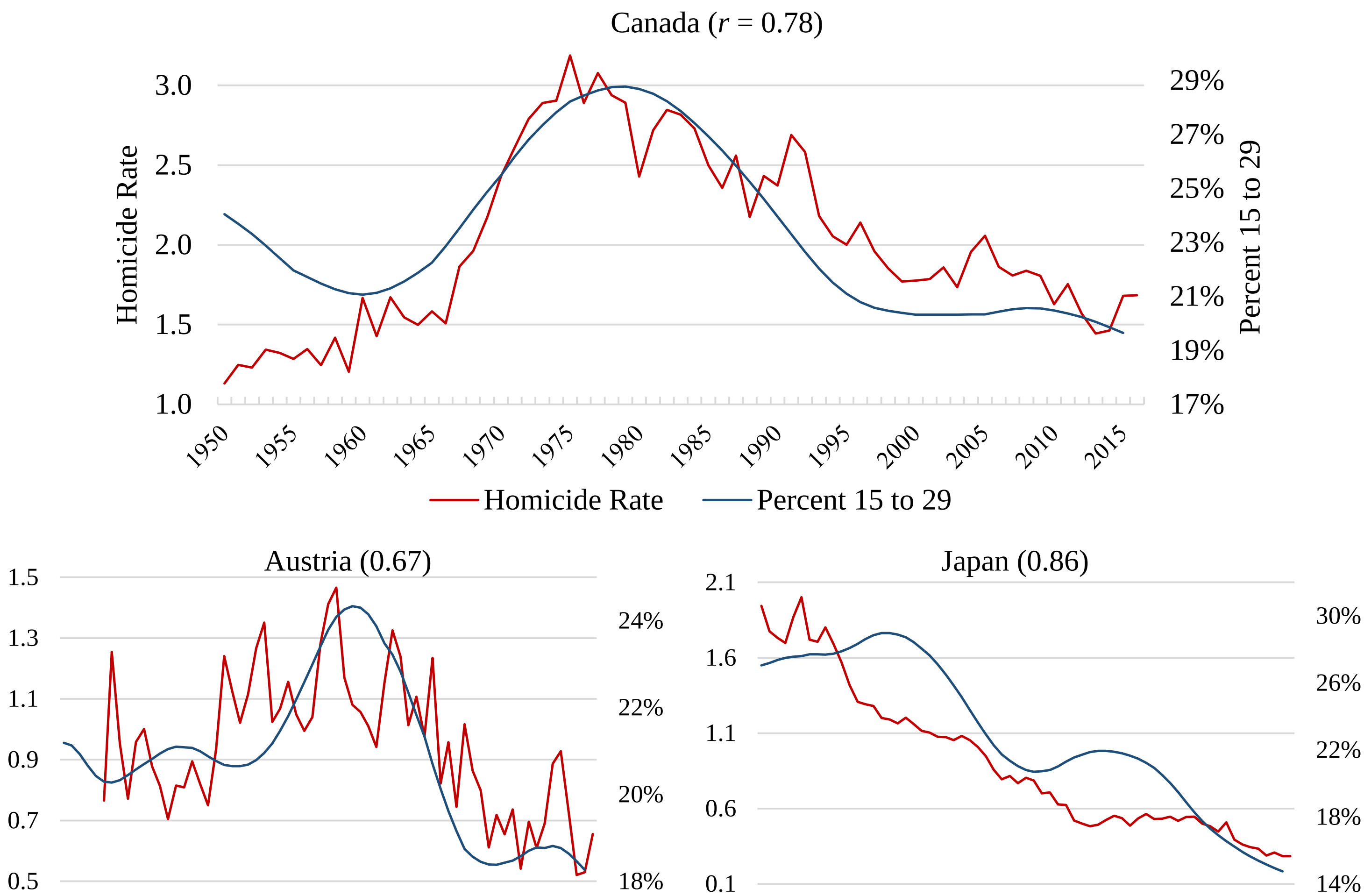


Source: World Population Prospects (UN)

Though at different times and intensities, all regions of the world experienced a decline in the proportion of their population between ages 15 and 29 (hereafter also referred to as percent youth, or percent young). Moreover, this declining trend is particularly strong in the most developed regions, which have participated in the International Homicide Decline (LaFree et al., 2015; Tseloni et al., 2010; Weiss et al., 2016). For example, in Northern America, the percent youth declined from 27.5% in 1980, to 20.7% in 2015, and in Western Europe the percent youth declined from 23.7% in 1987 to 17.2% in 2015.

As an equally international phenomenon, I argue that changing aging structure is a plausible cause for the International Homicide Decline. The following figure displays the trends in the percent 15 to 29 and in Homicide Rate for Canada, Austria and Japan. In parenthesis is the Pearson Correlation between both series. Besides the United States, these were the three countries which had the largest positive correlations.

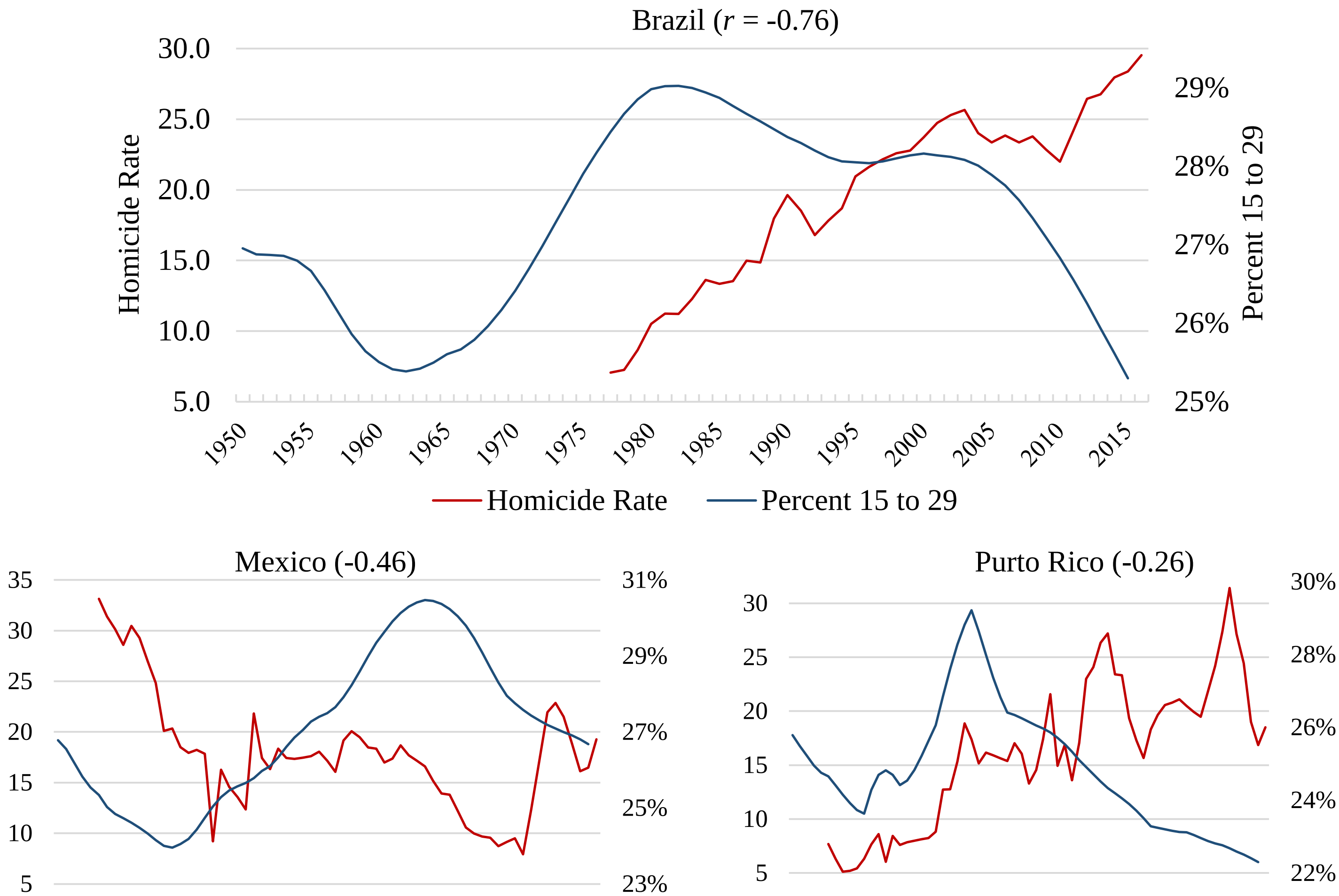
Figure 1.8: Homicide Rate and Percent of Population 15 to 29 – Selected Positive Cases, 1950 to 2016



Source: United Nations Office on Drugs and Crime / World Health Organization / World Population Prospects (UN)

Each of these countries is in a different region of the world. However, despite their geographical distance, these three countries share many commonalities. First, all three have experienced sharp declines in their populations between 15 and 29 years of age, while homicide rates were declining. All three are also developed democracies, where their populations enjoy social and political stability (Marshall & Elzinga-Marshall, 2017). In stable and relatively safe countries like these, there seems to be a strong association between age composition and homicides trends since 1950. There are, however, countries where this relationship is not as robust, as illustrated in the following figure.

Figure 1.9: Homicide Rate and Percent of Population 15 to 29 – Selected Negative Cases, 1950 to 2016



Source: United Nations Office on Drugs and Crime / World Health Organization / World Population Prospects (UN)

Brazil, Mexico and Puerto Rico also share many commonalities.[5] They are all in Latin America, all three have some of the highest homicide rates of the world, and all three have experienced the influence of organized crime, social instability, and an economic downturn or other source of social instability over the course of the last seven decades (Briceño-León et al., 2008). While all three countries also experienced a sizable reduction in their population between 15 to 29 years, homicide rates have not followed the same trend as in countries with greater social stability, and instead have increased considerably in the most recent decades.

Dissertation Overview

The above descriptive analyses suggest that changes in age composition generate major demographic pressures on homicide trends. That effect, however, is not observable when levels of violence are already high, or when there is a heightened influence of other sources of social and political instability. Therefore, the directly observable effect of age composition on homicide trends appears to be conditional on the absence of other criminogenic forces driving homicide trends.

As exemplified by the crack epidemic in the United States, some period effects and other social forces can have a major impact on crime that can interfere with the pacifying influence of an aging population. One possibility is that, by

[5] These three countries had the largest negative Pearson Correlations amongst the countries with available data.

dictating much of the change in homicides over a certain period, certain events can hide the association between homicides and age composition – a relationship which may become of second-order importance when other criminogenic forces gain prominence. Moreover, as may have been the case during the crack epidemic, these social phenomena themselves may be a consequence of an increased proportion of individuals at younger age groups.

The current dissertation purports to be a test of the above propositions. First, I utilize innovative datasets and a longer-term perspective to test if there is indeed a macro-level association between changes in age composition and homicide trends. While this test begins as an attempt to explain the International Homicide Decline, it develops into a broader explanation of macro-level changes in homicides more generally. Second, I explore variations in the relationship between age composition and homicides. In particular, I attempt to explain the negative cases: countries where changes in age composition have not been reflected in changes in homicides. In doing so, I show that the directly observable effect of age composition on homicide trends appears to be conditional on the absence of other criminogenic forces driving homicides. As one potential explanation for this finding, I propose that demographic forces may be constantly pressuring homicide rates, but that the effect of age is secondary, and may simply be omitted when other major criminogenic forces are pressuring homicide rates higher.

Chapter 2: Age and Crime

The present chapter elaborates on the theoretical mechanisms that would link a greater proportion of individuals at a certain age range to higher rates of homicides. The chapter begins by providing an overview of the literature linking age with changes in the propensity for criminal offending at the individual level. I then revise some of the theories that have extrapolated this individual-level relationship to the macro level of populations, by predicting an association between a population's proportion of individuals at an age group and homicide rates. The chapter concludes with a review and a discussion of recent empirical research testing the association between age composition and homicide rates.

Age and Crime Theory

Micro-Level

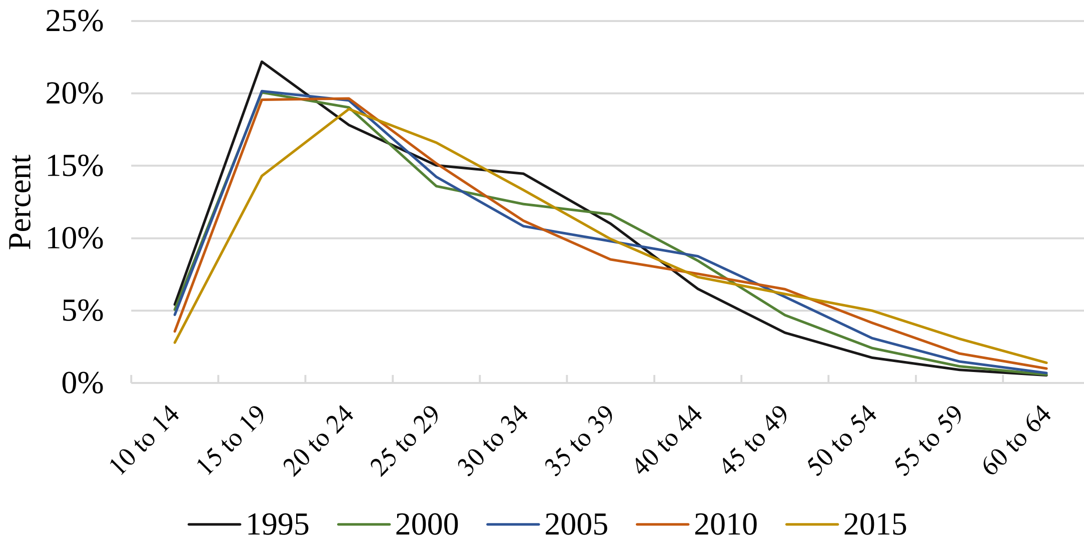
For centuries, age has been recognized as one of the most robust predictors of criminal behavior. Already in the1800s, the French astronomer and statistician Adolphe Quetelet documented the way crime in rose with age, peaking around the early 20s and declining thereafter. In observing this pattern, Quetelet (1831) wrote: "among all the causes which have an influence for developing and halting the propensity for crime, the most vigorous is, without contradiction, age." In the decades that have passed since Quetelet's observation, voluminous literature has documented existence of an inverted J-shaped age-crime curve (Farrington, 1986; Hall, 1916; Hirschi & Gottfredson, 1983; Steffensmeier, 1989; Sweeten et al., 2013).

The strength and robustness of the relationship between age and criminality is such that some scholars have suggested that "the age distribution of crime is invariant across social and cultural conditions" (Hirschi & Gottfredson, 1983: p. 554). More recent and nuanced research has questioned the robustness of this invariability, finding evidence of significant variations in the relationship between age and crime both over time within the United States, and across cultural settings, particularly in India (Steffensmeier et al., 1989; Steffensmeier et al., 2018). Still, while interesting variations exist in the level of concentration, the few studies that have investigated the age distribution of violent offending internationally have found that violent criminality is always more prevalent amongst the youngest segments of society (Epstein, 2007; Goode, 2008; Junger-Tas et al., 2009; Steffensmeier et al., 2017; Tittle & Grasmick, 1997). Thus, while the *invariance* of the age and crime curve has been questioned, and is likely an overstatement, the *universality* of a relationship between age and violent offending is much less controversial (Steffensmeier et al., 2018).[6] Figure 2.1 displays the proportion of arrestees for violent crimes by age group for every five years between 1995 and 2015 in the United States. Arrest data was obtained from the Uniform Crime Reports of the FBI. Though the figure is a measure of law enforcement that may not necessarily reflect criminal activity, it illustrates the

[6] It should be noted, however, that this literature is still very restricted, particularly due to the lack of data on the age distribution of offenders outside the western world. The study of Steffensmeier and colleagues (2018) is an innovation in that direction, and may serve as a model for future research.

consistency in the age and crime relationship over the span of 20 years. Generally, while variations do exist, those aged 15 to 29 years of age consistently represented about 20% of the overall population of the United States, but were responsible for between 49.8 and 55.1% of all arrests for violent crimes in the country.[7]

Figure 2.1: Distribution of Violent Crime Arrestees by Age Group and Year – United States, 1995-2015



Source: Federal Bureau of Investigation (US)

Because of the strength and the consistency of the relationship between age and criminal offending, virtually all individualistic theories about crime have an age component. Even self-control theory, which explicitly abstains from explaining the

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[7] These contextual variations in the age and crime relationship are a rich topic of research, which I intend to explore in future studies. Generally, a higher concentration of criminal offending at younger age groups is seen in countries where, and at times when homicide offending is highest (United Nations Office on Drugs and Crime, 2013). This relationship suggests that young crime is a driver of variations in homicide rates over time, and across places.

age and crime relationship, recognizes the strength of the association, and shapes its propositions around it (Gottfredson & Hirschi, 1990). Generally, criminological theories agree that younger individuals have greater motivations and/or have more opportunities for committing crimes (Phillips, 2006). The following paragraphs review some of the most common perspectives that attempt to explain the individual-level age and crime relationship.

A *strain perspective* holds that a disjunction between the desired goals that society instill in individuals, and the distribution of the means to achieve such goals, is a major motivator of crime (Merton, 1938). According to this perspective, crime is often a coping mechanism to a circumstance of adversity, in which individuals feel that they are not being provided with the fair means to obtain the material things and the social status that is desirable in their culture. On one side, deprived individuals should feel more compelled to achieve some of those goas through illegitimate means, which should explain a higher propensity for property crimes. In addition, deprivation can also lead to feelings of frustration and rebellion, which should explain a higher participation in violence (Felson, 1992). Empirically, one of the main causes of strain is inequality, which is consistently found by comparative research to be one of the main predictors of the differences in violence across places (Kelly, 2000; LaFree, 1999; Nivette, 2011; Rennó Santos et al., 2018).

Some studies have also linked the prevalence of strain to age, and have used this concept to explain variations in criminality over life (Greenberg, 1977, 1985). Those studies have proposed two parallel mechanisms within a strain perspective. First, youth may have worse labor market and income opportunities, while being emotionally susceptible to pressures for status that motivate crime (Greenberg, 1985). At younger age ranges, individuals are most vulnerable to social pressures, particularly by peers which may over-emphasize the social and material goals of society, coupled with disdain to the legitimate means to achieve these goals. Furthermore, as individuals age they become more capable to achieve socially desirable goals through legitimate means, particularly because they are likely to obtain legal employment, and because their earnings from this work tend to increase (Grogger, 1998). As an additional benefit, employment adds a range of pro-social peers to individual's interactions, thus diminishing peer pressures towards illegal activities.

Young men in particular have few available mechanisms to demonstrate their masculinity and to obtain respect from their peers besides engaging in illegal acts of rebellion, drug abuse, and in the use of violence (Messerschmidt, 1993). This depravation in means to obtain social status may be particularly prominent among economically disadvantaged youth who, in addition to feeling more strain due to their economic deprivation relative to wealthier youth, are not able to obtain prestige by displaying economic wealth. Some of these youth may feel they have no alternative to obtain status besides engaging in violence, particularly when these individuals perceive a threat to their personal honor (Anderson, 1990, 1999).

A *social control perspective* shifts the explanation for the causes of crime to the causes of the abstinence from crime. Originally, four elements were described as prime sources of controls that mitigated crime involvement: attachment to pro-social sources, a commitment to legitimate activities and institutions, a high degree of involvement with those activities, and the belief that societal rules are morally correct and should be obeyed. Overall, the stronger the bonds to conventional society, the less likely an individual is to violate the law (Hirshi, 1969; Nye, 1958; Reckless 1963; Reiss 1951).

Adolescence and young adulthood are naturally times of shifting ties, when the control from pro-social institutions such as the family and school may weaken as individuals are attempting to exert their own independence and identity (O'Brien & Stockard, 2002; Tittle, 1988). Over that life period, lessening controls frees individuals to violate norms and to engage in crime, a risk that is particularly high for disadvantaged youth who receive the least amount of monitoring and supervision (McLanahan, & Sandefur, 1994; O'Brien et al., 1999). Over time, however, as individuals' age increases, so does their involvement in conventionality, and their stakes in conformity (Toby, 1957). These changes in social control over life are well elaborated within a Life-course perspective, which describes sources of changes in social control though life, and how those changes exert key influence in explaining both the onset of criminal involvement, and eventually desistance (Sampson & Laub, 1993; Laub & Sampson, 2003). Generally, as life happens, as families begin, as children are born and as individuals become invested in their careers, the control generated from each of these sources, and from other pro-social institutions override the criminality of even the most hardened criminals. Thus, the involvement with crime is often a transitional phase between turning points, when social control is low.

Finally, an *age and aggression perspective* emphasizes the biological and psychological changes that occur though life in explaining differences in crime involvement. Generally, this perspective holds that as individuals age, they develop better emotional regulation and increased maturity that leads them to commit less crimes, in particular violent offenses (Lie et al., 2013; Marsh et al., 2013). In part, that relationship stems from an improved ability to deal with negative emotions, such as strain. By a simple consequence of individuals' ability to learn, older individuals are more likely to have understood that the largest burden of their aggression falls on their own shoulders. That realization, coupled with an increase in a longer-term perspective of the consequence of one's actions[8], may not necessarily decrease aggression, but it changes individual's reaction to aggression, as they develop other coping mechanism to negative emotionality. In addition, older individuals are likely to have less problems that would stir aggression to begin with, as they are more likely to live surrounded by more socially and economically stable contexts. This progress has been called the Dolce vita effect, which is based on the premise that life is somewhat harsher during youth than at other ages (Marsh et al., 2013). Generally, youth are required to engage in much more competition in society to obtain employment or to construct a family. Much like the social control perspective, this argument speaks about the impact of the family, employment, and of other social institutions. However, it sees the impact of those institutions as a reducer of sources of aggression, instead as a source of social control.

[8] Which parallels with the concept of Thoughtfully Reflective Decision Making (Paternoster et al., 2011)

Arguably, the onset of aggressive behavior actually occurs at a very young age, before age 2, and decreases through life, as individuals progressively learn better ways to cope with their negative emotions (Tremblay et al., 1999, 2004). This perspective is most interesting as it places the emphasis of individual aggression at very early ages, when families and the education system are most capable to intervene. Furthermore, this perspective instills the argument that it is not aggression per se that increases through the early teens. Instead, what increases are teenagers' ability to cause physical harm, due to improvements in their physical conditioning.

Another psychological explanation for the age and crime association is found in Moffitt's dual taxonomy model (1993). This perspective describes two qualitative distinct types of offenders. The first are the life-course persistent offenders, a small minority of the entire population who initiate their involvement with delinquency at a very young age, and who do not desist. The second group consists of individuals whose involvement with crime is limited to their adolescence years. The latter corresponds to the vast majority of the population, and only engages in crime because of a maturity gap which occurs at a time when these individuals desire, but are denied more freedom to do what they please. According to Moffitt, antisocial behavior is simply a coping mechanism to a maturity gap, when the adolescence-limited group emulates the anti-social behavior of the life-course persistent offenders, who are perceived as more mature. The adolescence-limited group, however, soon desists as they are progressively awarded more freedom by society, and as they mature.

The single group that never engages in criminality, considered a minority, corresponds to those who never feel the need to cope with a maturity gap. Though I categorized Moffitt’s arguments as a psychological perspective, there is a large parallel between her proposition and strain theory, particularly with the proposition that violence is a coping mechanism to negative emotionality.

Together, the multitude of theoretical perspectives reviewed in this chapter reach the same conclusion: youth are more likely to be criminal offenders and engage in lifestyles that put them disproportional at risk for victimization. These perspectives explain why individuals at younger ages are more likely to be involved with crime. The following sections review the theories and perspectives that have extrapolated that individual-level relationship to explain aggregated crime rates.

Macro-Level

Two main theoretical mechanisms predict that a larger proportion of individuals at younger ages (i.e. age composition) influence aggregate rates of homicides at the macro level.

The first is a simple compositional effect, also referred to as a *simple aggregate effect* (Firebaugh, 1978; Hirshi & Gottfredson, 1983; O’Brien et al., 1999). Quite simply, this proposition is an extrapolation of the individual-level relationship between age and crime to the macro-level. As the strong relationship between age and criminal offending is largely consistent across individuals, an increased proportion of individuals at younger ages should invariably increase the availability of potential offenders from an increase in the population in crime-prone ages. In addition, as the lifestyle of the youth places them at greater risk of violent victimization, an increase in the young population should also increase the availability of potential victims (Miethe & Meier, 1994). Hence, with all else being equal, countries should have higher levels of violence when a greater proportion of their population is young (Cohen & Land, 1987; Fox, 2000).

The simple aggregate effect perspective directly infers an aggregated level relationship from an individual-level association. Thus, this perspective potentially incurs in an atomistic fallacy (Leyland & Groenewegen, 2003). That type of fallacy is particularly an issue when this type of inference is made automatically, and without consideration to the distribution of a certain behavior or characteristic across individuals of a given population. For example, in a study written by colleagues and I about the causal relationship between fish consumption and homicide rates, we noted that while a relationship between consuming fish and aggression seems to exist at the individual level, that consumption varies greatly by level of income within a population (Testa et al., 2018). Therefore, a causal relationship between fish consumption and aggregated homicide rates cannot be inferred automatically from an individual-level association, without first considering how that consumption is distributed across the population. For instance, if indeed those at greatest risk of criminal involvement are able to afford a diet rich in fish.

While an atomistic fallacy is a risk that deserves consideration, the issue is not as concerning for the relationship between age and crime. As described by much of the criminological literature, a decline in crime with age is characteristic of the vast majority of the population (Gottfredson & Hirschi, 1986; Moffitt, 1993). Thus, while variations may exist, the distribution of the effect of age across individuals is so widely felt, that an individual-level relationship between age and crime can support the expectation of a macro-level relationship, without the risk of an atomistic fallacy (Firebaugh, 1978).

A second macro-level perspective speaks about the social consequences of a disproportionally large cohort of individuals at younger ages relative to the rest of the population. This perspective is referred to as *relative cohort size*, and is based on the studies of Easterlin (1978, 1987), an economist and demographer concerned with the consequences of the increased fertility following World War II, which was experienced by the United States and by several other countries worldwide.

The original studies by Easterlin (1978, 1987) emphasized the impact of cohort size on behavior, and on labor market conditions. Youth who are members of relatively large cohorts should face a range of labor market disadvantages because they generate an oversupply of labor, which is likely to supersede the number of new job openings. Specifically, to absorb a larger cohort of workers, the job market needs not only to replace the jobs of individuals retiring from the market, but also to create a much larger number of new positions to accommodate the incoming cohort. Hence, competition is much greater, increasing the probability of unemployment, and reducing opportunities for wage growth.

Subsequent research has confirmed that, indeed, members of relatively larger cohorts experience lowers wages, but studies also found that these individuals experience faster wage growth. The explanation for the latter is that when early opportunities for employment mingle, many individuals opt for a greater investment in education, which tends to provide good returns over time (Murphy et al., 1988). Nonetheless, not all youth are financially or otherwise able to invest in their education. In addition, as wage growth takes time, members of larger cohort spend much of their youth experiencing tighter labor market conditions, resulting in strain and incentivizing crime.

In parallel, members of relatively large cohorts may be more likely to offend because of a proportional decrease in the number of older adults providing them with supervision and support (O'Brien et al., 1999; Steffensmeier et al., 1992). First, a smaller adult to child ratio may reduce the amount of monitoring available by parents and the community, as less adults will be available to give direct attention to a much larger number of youth (Cook & Laub, 2002; O'Brien et al., 1999). Consequently, youth will likely spend more time with other individuals of their own age group, often without the supervision of an older adult, increasing the influence by peers within unstructured socializing settings that may be criminogenic (Osgood & Anderson, 2004). In addition, schools, churches and other institutions that provide services to the youth will be overburdened by a sudden increase in clientele, and will be more likely to have their resources overstretched. As a result, youth in larger cohorts may feel alienated, harboring feelings of pessimism and skepticism towards other segments of society (Kahn & Mason, 1987). Such feelings can have implications for political participation and for civil obedience, and may be aggravated by the difficulties in the labor market, and by the diminished number of interactions with individuals of other age groups.

In short, a higher proportion of youth may impact homicides rates either because youth are individually more likely to engage in violent offending, within a compositional perspective, or because young members of larger cohorts face a range of social disadvantages due to the relative size of their age group. Many other propositions for the relationship between age composition and homicide rates can be derived from these two larger perspectives. For instance, a more youthful population may have less capital available to invest in their communities, or may be themselves less invested in their current places of residency, with consequences to the social organization of the communities where they reside (Sampson et al., 1997; Bellair & Browning, 2010). Moreover, when organized crime and the drug trade is operated by a younger population, without the administration of older adults, those illegal operations are likely to become much more lethal, as was the case of the crack trade in the US during the epidemics (Blumstein, 1995). Both the above circumstances are more likely when the population of youth is greater, or when less older adults are available.

Most literature linking, or investigating, the relationship between age composition and macro-level crime rates either does not discuss a mechanism more directly, or assumes a macro-level association from an individual level relationship, in line with a compositional perspective (Rogers and Pridemore, 2017). While relative cohort theories were once central in the discussion, they lost appeal, perhaps because young cohorts are not as large as they once were during the 1970s. Nonetheless, while both theories provide very compelling arguments linking age and aggregate crime rates, the perspectives are not mutually exclusive, and their effects can coexist without issue. As in past literature, the current study places greater emphasis on a compositional effect, under the premise that this perspective is more fitting in explaining a general impact of age composition on homicide trends, regardless of the size of the young population relative to older age groups. Furthermore, this focus enables a direct comparison between findings of the current study with the methods and findings of contemporary criminological research, as nearly all criminological literature that has explored the effect of age composition on homicide trends has done so using the percent of the population within a certain age range – usually between 15 to 24, or between 15 to 29 years of age. Finally, a compositional effect should be more general than a relative cohort size effect. The latter is simply an extrapolation of an individual-level relationship that has been largely explored by criminological literature. In contrast, Relative Cohort Size was not originally conceived as theory of crime. Even though crime implications have been extracted from the original propositions of Easterlin (1978), these extrapolations imply a certain relationship between cohorts – that older cohorts supervise and support the youth – that may not necessary be applicable to all countries worldwide, and which may be much less general than an effect associated with the Simple Aggregate Effect perspective. In contrast, an increase in the crime-prone individuals with an increase in the percent youth should be more universal. Nonetheless, regardless the above arguments the current study also explores measures related to the Relative Cohort Size perspective.

Macro Level Evidence

All above theories predict that countries with higher proportions of youth should have higher levels of crime. Accordingly, many national and international studies include the percentage of a country's population that is young as a variable in studies estimating cross-national homicide rates. Surprisingly, recent reviews of the empirical literature have consistently found either a weak or a null association between age-structure and country-level homicide rates (Nivette, 2011; Rogers, 2014, Rogers & Pridemore, 2018).

Using data from the United States from 1992 to 1996, Steffensmeier and Harer (1999) found that age composition had only a small contribution to the crime drop in the United States. A second study by Levitt (1999) again utilized projected data from the United States from 1995 to 2010, finding that while age structure has some contribution to aggregate crime trends, that effect is small and inexpressive relative to the huge changes in the US homicide rates over the 1990s. A third study by Phillips (2006) used county-level data within the United States to explore trends in homicide rates from 1970 to 1999, finding that while age composition is indeed related to homicide trends in safer years since 1995, that association is non-existence during the 1970s and 1980s, when homicides were very high. The author's explanation was that, at times of increased violence, criminogenic pressures such as adverse economic conditions pressures all age groups, and not just the younger, to criminal offending. Implicitly, Phillips (2006) proposes that adverse macro-level conditions can change the age distribution of offending, in particular by reducing the concentration of offending among the youth.[9] Other studies have also found that the

[9] This proposition directly contradicts Blumstein's (1995) which directly linked the homicide increase during the 1980s to an increase in violence among youth in inner cities. Hence, Blumstein proposes that the concentration of violence at younger ages increased when homicide rates were higher in the United States, as the large

impact of age in driving homicide trends in the United States is either non-existent, or secondary relative to alternative explanations (Blumstein, 2006; Fox, 2000).

Studies using comparative data for multiple countries reached very similar conclusions. A study by Gartner and Parker (1990) compared the predictive power of age composition on aggregate homicide rates for five countries, namely the United States, Italy, Scotland, Japan and England. The authors concluded that age composition was only able to explain little of the homicide trends of each of those countries since World War II. Several studies by Rogers, some coauthored with Pridemore (Rogers, 2014; Rogers & Pridemore, 2016, 2017), used recent cross-national data to demonstrate the weakness of the impact of age composition in explaining differences in homicides between countries, going as far as to suggest that cross-national investigations should refrain from adding controls for the percent of the population at younger age ranges.

Two systematic reviews of the literature have taken stock of the macro level relationship between age composition and homicides. First, a publication by Marvell and Moody in 1991 reviewed 90 studies which regressed crime rates on age structure dating as far back as the early 1970s, mostly using United States data. Their review found conflicting results in the literature, which generally tended to find an association between age and the probability of arrest, but which also failed to find an

availability of youth was itself a driver of the crack epidemics, and of its associated lethality.

association between the proportion of the population at younger ages and crime rates. These discrepancies were mostly explained by a range of methodological issues with prior literature, including small samples sizes, and its inability to account for competing explanation of crime rates. In addition, the authors argued that arrest data alone is a measure of enforcement, and not of crime itself, and may reflect the inability or lack of resources from younger cohorts to avoid being caught and punished for offenses committed. Therefore, based on these findings, the authors concluded that the age and crime relationship was actually much weaker than suggested by prior criminological literature. Demographic forces, the authors argue, are not sufficient neither to explain changes in crime, nor to forecast future trends.

A second systematic review was a comprehensive evaluation of the association between percent young and homicide rates across comparative international research, which was published by Rogers and Pridemore in 2017. The authors reviewed a total of 32 studies, which together contained 146 models regressing homicide rates on the proportion of the population at young ages. Only 19 of these 146 models (13%) found the expected positive association between age composition and homicide rates. From the remaining, 120 models (82%) did not result in a significant association, and seven models (5%) actually yielded a negative association. Even more consistently than Marvell and Moody (1991), Rogers and Pridemore (2017) found that percent young is not a consistent predictor of homicide rates, and that the inclusion of the measure in regression models, while supported by theory, is not justified by the wealth of empirical evidence accumulated in the field.

In the same publication, Rogers and Pridemore (2017) conducted their own analyses using a sample of 55 countries from the World Health Organization (WHO) between 1999 and 2005. In this analysis, the authors not only found that indeed percent young has no association with homicide rates, but also that the inclusion of the variable has negative implications for model fit, a problem caused by the strong relationship between percent young and poverty rates. Accordingly, the authors hypothesized that percent young may have been operating as an alternative measure of economic wealth, as economically disadvantaged countries have lower life expectations, and consequently display a greater proportion of individuals at younger ages. Throughout their study, Rogers and Pridemore made no distinction between studies measuring the difference in homicides between countries (cross-sectional), from studies measuring changes in homicides over time (longitudinal).

In addition to the proposition that percent young is a proxy for poverty, two other explanations have been proposed in the literature for the lack of an effect between age composition and macro level homicide rates. First, Pamper and Gartner (1995) have proposed that age and crime might not have the relationship they once had due to the development of strong national institutions for social protection which may have provided the youth with services that mitigated the association between percent young and homicides. In addition, the review by Marvell and Moody (1991) argued that the age and crime relationship may partially be driven by the inability of younger individuals to avoid arrest, and by the fact that many youths offend in groups, thus involving more persons in a single offense. Therefore, it may not be that youth necessarily cause more crime, but simply that more youth are arrested for the crimes they cause.

All three hypothesis above were offered as concluding remarks. Hence, none were directly tested. They were made in the form of broader speculative hypothesis to explain the absence of an effect between age composition and crime rates – a finding that still lacks theoretical support and elaboration.

The Contradiction

A review of the current literature on the age and crime relationship exposes a very intriguing contradiction. On one side, robust evidence exists of the individual relationship between age and individual criminal offending, at such a high degree, that this association is in the fundament of the current theoretical framework of the entire field of Criminology. Robust theories exist to explain that individual level relationship, including *strain*, *social control*, and variation in *aggression*. Furthermore, strong theories exist for why a larger proportion of individuals at younger ages would entail higher rates of crime, either from a simple extrapolation of the individual level association, as proposed by a *simple compositional effect*, or from the added disadvantages of youth who are members of larger cohorts, as proposed by the *relative cohort size* theories.

On the other side, the overwhelming majority of the findings from current empirical studies has failed to find an association between age composition and rates of crime. In fact, that failure is so consistent, and so long-standing, that it has led some to question the strength of the age and crime relationship (Marvell & Moody, 1991), and has fostered novel propositions explaining the lack of a macro level association between age composition and homicide rates (Pamper & Gartner, 1995; Rogers & Pridemore, 2017).

This contradiction has several methodological and theoretical implications, which are deserving of a detailed investigation. While automatically inferring an aggregate level relationship from an individual association may constitute an atomistic fallacy, the strength and generality of the individual relationship between age and crime is such that it justifies the expectation of a macro level effect. Particularly when changes in age composition are as intense and as broad felt as they were over recent decades, these should result in a range of social outcomes that would also be consequential for crime.

The absence of a consequence is surprising, and requires an explanation. If a macro level relationship between age composition and homicide rates does not exist, while age and individual criminality are so strongly linked, it must be because of the influence of something interfering in that transition. Either the strong relationship at the individual level is an artifact of our measures, as proposed by Marvell and Moody (1991), or youth become less violent when they are more prevalent, directly contradicting relative cohort size theories (O'Brien et al., 1999), or through some other unknown mechanism. As currently proposed, none of the explanations for the null association between age composition and crime are sufficiently convincing or empirically supported.

In the current study, I hypothesize that age composition explains many of the changes in homicide rates over the past decades. That hypothesis is based on the premise that variations in the relative size of younger cohorts will be consequential for homicide trends. Hence, this study contradicts the findings of much of the past empirical studies on this association. I argue, however, that findings for a null relationship might have been a consequence of shared limitations in macro level research, which I attempt to address.

Chapter 3: Theory and Hypotheses

I begin Chapter 3 by proposing the empirical reasons I believe past research found a null association between age composition and homicide rates, even though such relationship may still exist. In addition, this chapter presents the theoretical and methodological ways this study advances the current state of the literature.

Potential Causes for the Contradiction

There are two possible explanations for the findings of previous literature of the absence of an effect between age composition and homicide rates. First, it may be that an effect actually does not exist (Marvell & Moody, 1991; Rogers & Pridemore, 2017). Second, the null findings may be an artifact of methodological limitations of previous research. The current section elaborates on potential issues related to the research reviewed in Chapter 2, and explains how those limitations may have helped shape the current state of the literature on the macro-level relationship between age composition and homicide rates.

First, *almost all comparative research on homicide trends utilize data from the same sources* (LaFree, 1999; Nivette, 2011). As described in Chapter 4, international organization, in particular the United Nations and the World Health Organization, have been the traditional institutions responsible for collecting and curating data on cross-national homicides. Consequently, nearly all studies on the topic, particularly in more recent years, have utilized data from the same original sources (Trend & Pridemore, 2012).

That homogeneity in source is not in itself a methodological issue. Statistical teams at both the UN and the WHO have been making great progress in the collection of international data, with developments that have supported much research over recent decades (United Nations Office on Drugs and Crime, 2017; World Health Organization, 2018). However, because of this homogeneity, a meta-analysis of research that uses these data, as the one executed by Rogers and Pridemore (2017), is not as useful a method for assessing the robustness of a relationship. The consistent findings of previous studies may simply be a consequence of the fact that researchers are repeatedly executing very similar analyses, using very similar data. An effective meta-analysis requires a sample of studies utilizing a range of methodological instruments, and varying samples that can speak about the internal and external validity of findings (Flather et al., 1997). Because of the homogeneity in the sources and methods used by comparative homicide studies, meta-analyses of this literature simply access that repetition, and speak very little about the replication of findings across diverse research configurations, thus lending little additional support for a conclusion.

A second issue is that *comparative cross-national data can be misused*. This is particularly a problem in cross-national research because derivative versions of the data files of the original sources are often republished by other sources, at times including imputations or other transformations of the raw homicide counts. These transformed data may be unsuitable for certain types of analyses. For instance, in addition to the raw original homicide counts, the World Health Organization also publishes age-adjusted homicide rates, in an attempt to account for the differences in age distribution when analyzing predictors of the differences in homicides between countries (Ahmad et al., 2001).[10] In another example, the WHO routinely publishes model-based estimates of homicides for countries where data are missing (World Health Organization, 2014). As these estimated values are produced using regressions models that include many of the predictors employed by comparative research, the resulting homicides counts are unsuitable for use in regression analyses. Still, researchers have often inadvertently utilized these estimates, particularly because these data are often mislabeled. Moreover, as researchers often do not report details about their original sources, readers may have difficulty in assessing the adequacy of the data used (Kanis et al., 2017).

A third issue is that analyses of homicide trends make use of *series that may be too small to observe the impact of long-term social processes*. Almost all studies which have found a null relationship between age composition and homicide rates have used either a cross-section of countries at a specific year, or a longitudinal sample with a relatively small number of years (Rogers and Pridemore, 2017). The following graph limits the trends in homicide and age composition for the United States to the years between 1999 and 2005 – the same period used by Rogers and Pridemore (2017) in their analysis.

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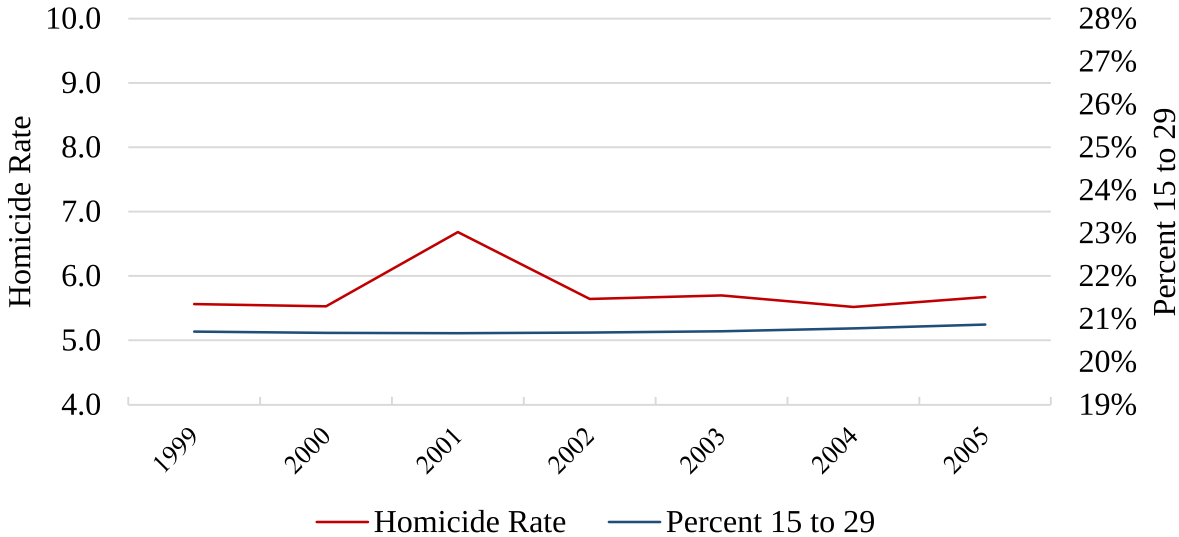
[10] Ironically, this transformation assumes a strong and consistent relationship between age composition and mortality rates. Age-adjusted homicide rates can be obtained from WHO Violenca nd Injury Prevention data portal (www.who.int/violence_injury_prevention/surveillance/databases/mortality/en/)

Figure 3.1: Homicide Rate and Percent of Population 15 to 29 – United States, 1999 to 2005 (*r* = 0.166)



Source: United Nations Office on Drugs and Crime / World Population Prospects (UN)

Across the seven years between 1999 and 2005, the Pearson correlation between the homicide rate series and the percent 15 to 29 series is of 0.166.[11] That small bivariate association could be understood as an indicator that a relationship between age composition and homicides does not exist. However, over that entire period, homicide rates remained almost constant at around 5.5 per 100,000 population. The single outlier is 2001, when terrorists murdered more than three thousand people, causing an increase in the homicide rate to 6.7. The same stability is observed in the percent of the population between 15 to 29 years, which remained almost constant at around 21% between 1999 and 2005.

[11] Between 1950 and 2015, that same correlation is at 0.803.

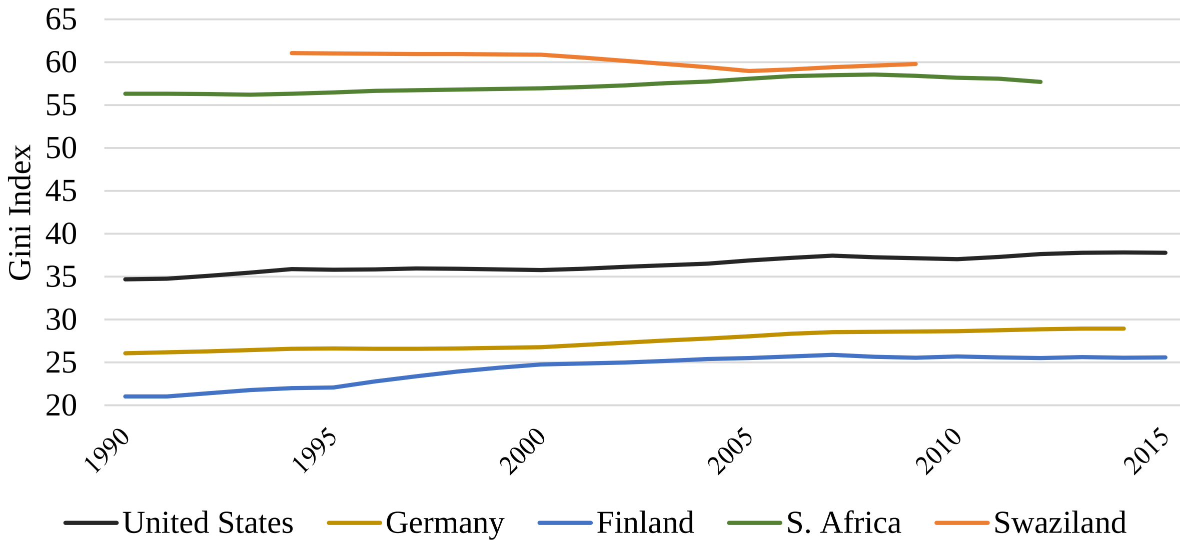
This absence of change is a serious methodological issue as it can artificially lead to null effects not because a relationship does not exist, but because the lack of variation inhibits the observation of co-variation (Wooldridge, 2002). Social and economic indicators, particularly when evaluated at such a macro level as countries, may take decades to change. That is particularly true for demographic shifts, which can take generations to unfold (Thornberry, 2005). Therefore, the observation of variation in the size of the population at certain age groups, and of its consequences, may require the use of data for much longer periods than a decade.

As shown in Chapter 1, in 1991 the homicide rate of the United States was at 9.7 per 100,000 individuals, at almost twice the rate of 1999. Similarly, while in 1999 the percent 15 to 29 was close to 21%, in 1980 that same proportion was peaking at 27%. A database that encompasses data on homicides and on age composition from the 1990s, the 1980s, and from previous decades would include much greater variation in both indicators, and would facilitate the test of co-variation

A forth issue is that *factors that explain the differences in homicide between countries may not necessarily be the same as the factors explaining changes in violence within countries over time*. This point relates very closely to the differences between cross-sectional and longitudinal investigations, which has been debated extensively in the criminal career research (Blumstein et al., 1988; Gottfredson & Hirshi, 1987; Piquero et al., 2008). Individuals may hold differences between each other that may explain why some involve themselves in crime when other do not. However, factors explaining those cross-sectional differences in involvement are not necessarily the same as the factors explaining onset or desistance from crime.

I believe the same argument is applicable to the study of crime trends. Countries can hold extreme differences between each other in social indicators, which can overshadow the change in these indicators over time. Figure 3.2 illustrates this point using the Gini Index, an indicator of income inequality collected from The Standardized World Income Inequality Database (Solt, 2016).

Figure 3.2: Gini Index – Selected Countries, 1990 to 2015



Source: Standardized World Income Inequality Database

The United States, as several other developed countries, is experiencing an increase in its inequality of income, a trend that has been a cause of much concern for economists (Piketty, 2015). Still, despite decades of increase, the Gini Index of the United States economy remained about half of the index of South Africa, and has always been about 30% greater than the index of Germany. While income inequality is a major predictor of the difference in homicide rates between countries, it often performs very poorly in longitudinal analyses (Pridemore, 2011; Rennó Santos et al., 2017), perhaps because income inequality tends to change relatively little over time.

As with income inequality, the relative differences in homicide rates between countries tend to be relatively stable over time. Moreover, nearly all existing literature focuses on the relationship between age composition and homicide rates is cross-sectional rather than longitudinal (Rogers & Pridemore, 2017; Rennó Santos et al., 2018), This is an important caveat, because while age-structure may not explain differences in homicide between countries, changing age-structure overtime may effectively explain changes in homicide rates within countries overtime. That methodological distinction between predictors of differences and predictions of change has been absent from crime trends research, and may be key in explaining inconsistencies of prior studies (Baumer et al., 2018).

A last issue is the *excessive reliance on average effects*, which often ignores the possibility of heterogeneity in the effect between two variables. To be sure, there has been similar concern by criminological research investigating the impact of specific deterrence on individual offending (Loughran et al., 2012), and even macro level research has proposed that predictors of homicides can depend on the level of violence in countries (Rennó Santos et al., 2018). Nuances can exist in the relationship between two variables in such a way that an existing causal relationship can be omitted by variations in effect that are conditional to a third factor. For instance, it may be that the effect of specific deterrence can depend on how punishment is perceived by offenders. This study expands on that literature by proposing that the effect of age composition on homicide rates can be muted by the influence of other criminogenic forces. Therefore, a direct effect of the percent 15 to 29 on homicide rates should be directly inverse to the level of homicide in a given country. This proposition has several parallels in the crime trends literature (Papachristos et al, 2018; Phillips, 2006) and in the risk factor literature (Hannon, 2003; Kahlmeter et al., 2017), which will be discussed in the subsequent section.

Variation in the Effect of Age on Homicide Rates

Literature on the risk factors related to juvenile delinquency and to adult crime has consistently found evidence that the absolute impact of each individual risk factor for offending becomes much less impactful when individuals concentrate a range of other disadvantages (Hannon, 2003; Kahlmeter et al., 2017; Raine, 2002). That phenomenon has been labeled "disadvantage saturation", and is a common occurrence because individuals experiencing a single risk factor are much more likely to also experience a range of other problematic experiences and behaviors (Biglan, 2004).

In addition to an intriguing finding, disadvantage saturation also creates methodological issues which are relevant to this project. Of most important, is that it generates heterogeneity in the effect of each individual risk factor, conditional on presence of other sources of disadvantage (Raine, 2002). For instance, studies using a high risk sample of offenders would be more likely to find smaller effects for individual risk factors than studies using broader samples drawn from the general population, where risk factors are more likely to occur in isolation.

In this dissertation, I argue that countries too can *concentrate disadvantage*. A country with a low income per capita would be more likely to also have an uneducated population, to have worse criminal justice institutions, to have fewer resources available to social support, and to suffer a range of other social and economic issues. In contrast, when the economy is well, other aspects of society which depend on the availability of financial resources are also likely to improve. In fact, macro social and economic indicators tend to be so strongly correlated, that their association often creates methodological problems of multicollinearity, which hinders the identification of the effect of a single country's characteristic net of other indicators (Pridemore, 2008; Pridemore 2011; Rogers & Pridemore, 2017).

In a study by colleagues and I (Weiss et al., 2016), we analyzed grouped trajectories of homicides for 53 countries between 1990 and 2005, finding evidence that the safest countries in the world experienced the strongest declines in homicide within that period. However, the decline became progressively weaker, and eventually turned to an increase, for countries which already had the highest levels of homicide in 1990.

Four other studies reached similar findings of stronger declines in the safest locations. A study by Tuttle and colleagues (2018) executed a replication and extension of my previous project (Weiss et al., 2016) using data for 82 countries between 1980 and 2010, and reached the same findings. In his 2012 book about Chicago, Robert Sampson presented evidence that the safest neighborhoods were the ones enjoying the greatest declines in violent crime, while the neighborhoods which already concentrated the greatest amount of disadvantage were either not participating in the decline, or were experiencing worsening crime rates. Another study by Papachristos and colleagues (2017) again reached a very similar conclusion in their analysis in Chicago, showing evidence that crime declined everywhere in the city, but that the decline occurred at a much greater intensity in neighborhoods that were already safer.

A final study that identified a similar pattern was an investigation by Julie Phillips (2006) of homicide trends using county level data for the entire United States between 1970 and 1990. Her research is particularly relevant for the current study, because the author was also exploring the association between age structure and homicide rates in the context of a decline in crime during the 1990s. The author found a strong association between the percentage young and homicide rates during the mid-to-late 1990s, but no effects during the mid-to late 1980s. Based on these findings, Phillips concluded that certain criminogenic forces (e.g. poor social and economic conditions) that influence crime trends, and which were very prevalent during the 1980s, can interfere with the association between percentage young and homicide rates. Her explanation for these findings was that at times when other criminogenic forces are most prevalent (as they were during the 1980s) all age groups within a population are more likely to be involved in crime, and not just the youth. Hence, Phillips implied that the age-concentration of violence amongst the youth is less prevalent when criminogenic forces are most prevalent and, consequently, when violence levels are highest.

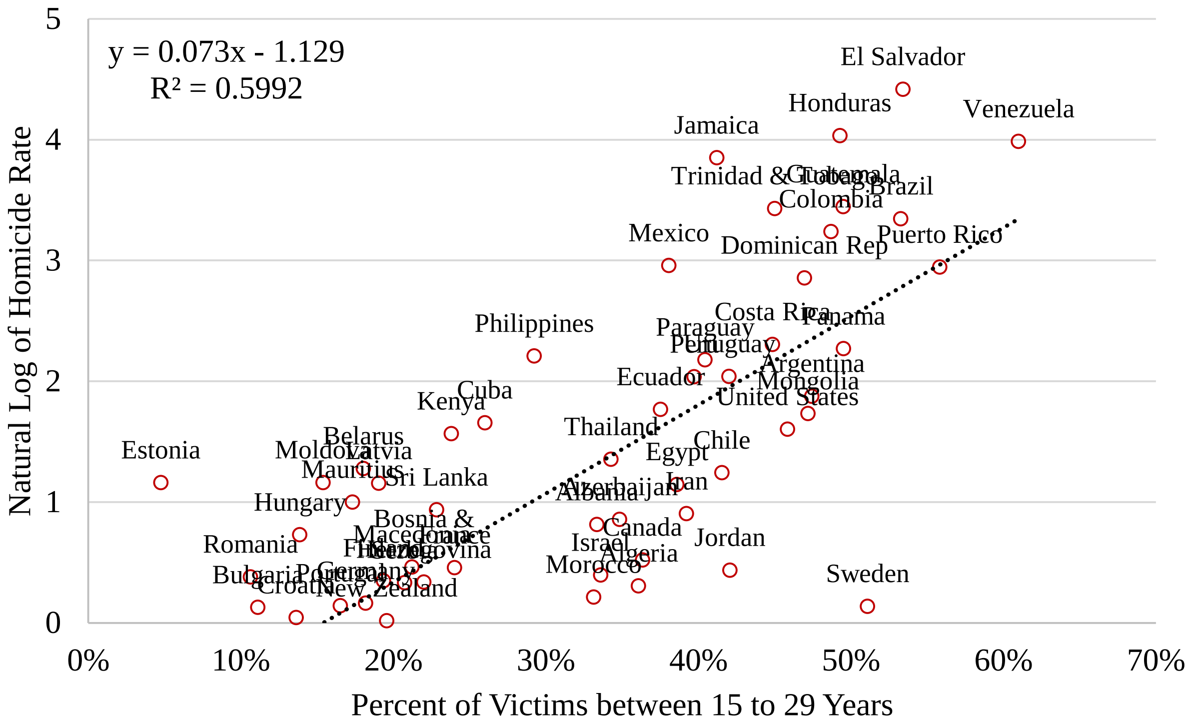
Considering the individual-level research on disadvantage saturation, and the extant literature, I believe another explanation is more plausible to explain Phillips' findings. Her conclusion implies that when other criminogenic forces are stronger, violent offending become much less concentrated among the youth, and is much more evenly distributed across age groups. However, there actually seems to exist a tendency for the opposite – that the youth participation in crime increases where crime rates are higher (United Nations Office on Drugs and Crime, 2014).

Figure 3.3 is a scatterplot illustrating the level of involvement of youth on homicides across countries. The graph utilizes data on the percent of homicide victims who are between the ages of 15 to 29 years. This data was obtained from the United Nations Office on Drugs and Crime, and is available for 72 countries.[12] This variable was plotted in the x-axis, against the natural log of the total homicide rate of that same country in the y-axis of the figure.[13] The purpose of this descriptive analysis is to compare the homicide rate of countries with the relative participation of youth in the homicides of a country. Ideally, this analysis should be executed using offender's, and not victim's, data by age group. Unfortunately, quality data about offenders is largely unavailable for the majority of the world's countries (United Nations Office on Drugs and Crime, 2014). That may be particularly an issue because of the very low clearance rates of the homicides of several countries, where most homicide perpetrators are never known to the police or the criminal justice system. Though countries in Western Europe can have clearance rates close to 98%, such as in Finland (Liem et al., 2018), that rate for high violence countries may be much

[12] Values correspond to a cross-section of the latest year with available data at or around 2015. The earlier year used for the graph was 2011.
[13] The natural log minimizes the influence of extreme values of homicides, which can negatively influence the visualization of the relationship between the variables in the figure.

lower - though data and research on this topic is still largely unavailable. Instead, I draw on the overlap between the characteristics of offenders and victims– a well-known phenomenon in Criminology (Berg et al., 2012; Jennings et al., 2010; Maldonado-Molina et al., 2010) – to assume that the age composition of homicide victims may serve as a proxy for the age composition of homicide offenders.

Figure 3.3: Scatterplot of the Natural Log of the Homicide Rate and of the Percent of Victims between 15 to 29 years of age – Latest Year (between 2011 and 2016)



Source: United Nations Office on Drugs and Crime

Figure 3.3 clearly shows that the percent of victims between the ages of 15 to 29 years is, on average, much greater for countries experiencing high levels of homicide. On average, each percentage point increase in the percent of victims between the ages of 15 to 29 years of age is associated with an increase of 7.6%[14] in the homicide rate of countries. The Pearson correlation between both variables equals 0.774, which is a high value. Latin American countries with very high homicide rates generally have a very high participation of youth among victims (e.g. Venezuela, El Salvador, Honduras, Brazil), while lower homicide countries such as Bulgaria, Norway, Japan and Spain all have relative low participation of youth in their homicides, all bellow or around 10%.[15]

Hence, in contrast to a decline in the participation of youth on homicides where homicide rates are highest, the above figure suggests the exact opposite trend – that the concentration of offending in the youth ages increases in high-violence locations. Blumstein (1995; 1997) implied the exact same increased involvement when explaining the 1980s crime increase of the United States, which the author argue was largely driven by an increase in the participation of youth in the drug trade, who acted as precipitators for the increased violence related to the crack epidemics. The following figure compares the homicide rate of the United States with the percent

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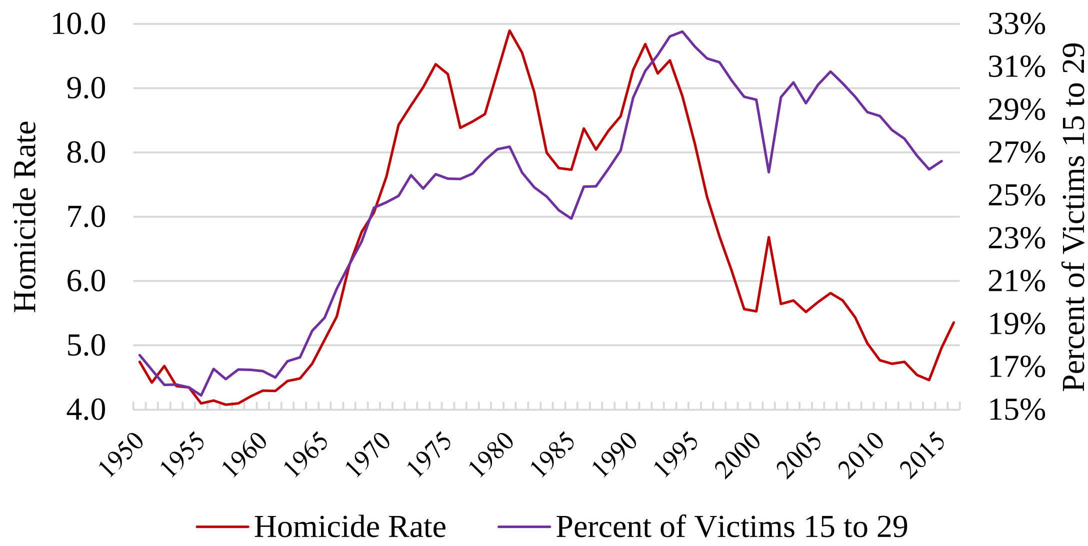
[14] This value equals to the exponential of the coefficient for the percent of victims between 15 to 29 years of age in a bivariate Ordinary Least Squares regression predicting the natural logarithm of homicide rates. The p-value related to that estimate is smaller than 0.001, as the 95% confidence interval is between 6.1% and 9.13%.

[15] This preliminary analysis may have several implications for the study of crime trends. In particular, it adds support for the conclusion that youth is the age segment driving the homicide rates of the most violent countries. These implications are deserving of more detailed research, which will be explored in future investigations.

of victims who were between the ages of 15 to 29 years.[16] Long-term data on victims by age group was obtained from the Mortality Database of the World Health Organization.

Figure 3.4: Homicide Rate and Percent of Victims 15 to 29 – United States, 1950 to 2015 (*r* = 0.861)



Source: United Nations Office on Drugs and Crime / World Health Organization

The graph suggests a positive and strong bivariate association between youth involvement with homicides and the homicide rate, expressed by a Pearson correlation of 0.861. During 1950s the proportion of victims between the ages of 15 to 29 was around 16%. Subsequently, that proportion had two major increases, both which happened concurrently to increases in the homicide rate. The first occurred during the 1960s, when that percentage increased sharply from 16.5%, to around

[16] Arrest data by age group in the United States is only available from the Federal Bureau of Investigation from 1995 to 2017 (https://ucr.fbi.gov/crime-in-the-u.s).

25%. The second increase occurred during the late 1980s and early 1990s, when the proportion of victims ages 15 to 29 increased to 32.6%. Since then, the proportion has been declining gradually, up until the value of 26.2% in 2015.

Both Figures 3.3 and 3.4 provide evidence for a positive correlation between the homicide rate, and youth participation in homicides. Therefore, it is unlikely that a reduction in the effect of age composition where (and when) homicide rates are highest is a consequence of an increase in offending for other age groups, as proposed by Phillips (2006). In fact, it appears that high levels of violence are often supported by an increased in involvement of youth on homicides.

One alternative explanation for the findings of Phillips (2006) is not that the effect of age recedes, but simply that the effect of other criminogenic forces can suspend the influence of age in dictating homicide trends. Therefore, at times or places where other criminogenic forces are most pronounced, the impact of age may not be directly observable because the high concentration of other disadvantages which are dictating the homicide trend, and which can overshadow any effect of age composition. In contrast, in countries where (and at times when) other drivers of homicide trends are absent, demographic forces may be most notable in determining changes in homicide rates over time.

This proposition would explain why crime rates in the United States increased with the crack epidemic (itself a very strong criminogenic force), when the percent young was already declining. It would also explain why the most violent countries are not experiencing declines in their homicides as their population grow older, as the influence of the concentration of other criminogenic forces is interfering with the pacifying influence of the aging of the population of those places.

Therefore, the level of *concentrated disadvantage* of a country may be a key source of heterogeneity in the effect of age composition on homicide rates. Moreover, this heterogeneity may be one possible explanation for null findings of previous literature, as the directly observable effect of percent youth on homicide trends may be conditional on a third factor which has been unaccounted for in past comparative literature – namely the absence of competing criminogenic forces driving the homicide trend.

Proposed Solutions

In this section, I present the ways in which the current project seeks to innovate from prior research, and how I believe those innovations may address the issues presented in the previous section.

The main solution is the use of a novel dataset on homicides that extends beyond the traditional sources of comparative data by used by extant research. That extension should be, to amount possible, in two directions. First, it should attempt to include a broader sample of countries, in particular countries with higher levels of concentrated disadvantage. Such sample would enable the identification of sources of heterogeneity in the effect of age composition on homicide rates by comparing the effect of age across countries with varying levels of disadvantage. Moreover, a broader sample would increase the external validity of estimates, thus making findings more applicable to explaining trends in crime which are being felt on a global scale.

Second, data should extend for as many years as possible, preferably encompassing a period which has experienced enough variation in age composition, and co-variation in homicide rates. As changes in age composition may take decades to unfold, such period should extend for several decades. Moreover, the series should cover periods when changes occurred in demographic composition.

As shown in Chapter 1, many countries experienced changes in their percent youth following World War II, for multiple reasons. Thus, ideally, a study that seeks to measure the impact of these changes in homicides should make use of data since the 1950s and 1960s, until the present.

As described in Chapter 4, colleagues from the United Nations Office on Drugs and Crime and I have worked in assembling a database on homicides with a much increased coverage of countries than existing sources. Moreover, for a smaller set of countries with available data, I used data from the World Health Organization to generate a combined homicide series spanning from 1950 to 2016. Such data allows the observation of the full impact of the aging of baby-boomers, and of the Demographic Transitions on age composition, and its corresponding impact on rates of homicides.

That dataset enables the assessment of the average impact of age composition on homicide rates, while also containing the coverage and the diversity to enable a broader exploration of variations in the effect of age composition on homicide rates. Moreover, a long series enables the investigation of factors related to change in homicide rates, which is the focus of the current study.

Table 3.1 summarizes the potential causes of the contradiction between the theorized and the observed effect of age composition on homicide rates. In addition, the table includes the ways in which the current research seeks to advance this investigation by addressing each of the limitations listed in this section.

Table 3.1: Potential Limitations of Previous Research and Proposed Solutions

Potential Causes for the Contradiction	Proposed Solutions
1. Almost all comparative research on homicide trends utilize data from the same sources	As its main data source, this study utilizes a novel database on homicide rates that has better coverage in terms of countries and years than previous available sources.
2. Comparative cross-national data can be misused	All data for the current study was collected directly from their original sources, with assurance that data only included actual counts, as opposed to estimates or any value that has undergone transformation.
3. Series that may be too small to observe the impact of long-term social processes	The current study utilizes data from 1990 to 2015 (26 years) for most of the world's countries, and data from 1960 to 2015 (56 years) for a subsample of 26 countries. Both of these samples cover a much greater number of years than most extant research investigating the impact of age composition on homicide trends.
4. Factors that explain the differences in homicide between countries may not necessarily be the same as the factors explaining changes in violence within countries over time	By emphasizing longitudinal predictors of homicide trends, the current study focuses on the exploration of the correlates of change, as opposed to the predictors of level, an investigation which is in line with the exploration of an International Homicide Decline.
5. Excessive reliance on average effects	The current study utilizes methods and model specifications that seek to identify sources of heterogeneity in the relationship between age composition and homicide trends.

Research Questions & Hypotheses

The current study seeks to identify the impact of changes in age composition on homicide trends. Specifically, it aims at identifying the effect of changes in the proportion of young individuals within a population. That broader research topic has four related question, which were defined by the current state of literature, and by the context of the international homicide decline.

First, this study explores *if an average relationship exists between age composition and homicides*. If, on average, a country that is experiencing an increase or decrease in its youth relative to other age groups should expect a change in homicide rates, net of other social indicators. Despite the wealth of evidence to the contrary (Rogers & Pridemore, 2017), the current study builds from an assessment of theoretical and methodological weaknesses of prior research to propose that an increase in the proportion of youth should have repercussions for homicide trends. Given all theory and evidence presented above, it may be possible to extrapolate a macro level relationship from the micro level association between age and criminal involvement. Moreover, demographic shifts constitute an immensely powerful social force, with a wide range of social and economic consequences (Kinsella & Phillips, 2005). It would be surprising if such consequences did not include homicide trends. Therefore, the hypothesis related to this first research question is that the average effect of percent youth is positive and above zero.

A second assessment concerns the exploration of *variations in the effect of age composition across regions*. In the current study, variations in effect were explored in relation to several country-level characteristics. That investigation has two purposes. First, it seeks to generate further evidence that certain regions of the world are not participating in the international homicide decline (Weiss et al., 2016; LaFree et al., 2015). Second, it explores why certain regions are experiencing declines in their young population, without a corresponding decline in their homicide rates. For the variations in effect by region, I hypothesize that the average effect of percent youth is positive and above zero for countries which experienced sizable declines in their homicide rates.

The current study makes two additional explorations which could add nuance to the average relationship between age composition and homicide rates. These investigations aim to investigate inconsistencies of prior literature (Phillips, 2006; Rogers & Pridemore, 2017), and why the most violent countries are not participating in the International Homicide Decline (LaFree et al., 2015; Weiss et al., 2016). First, I explore *whether the effect of age composition on homicide trends is conditional on the level of stability of countries*. In particular, I explore whether the directly observable effect of percent youth on homicide rates is greater for countries where, and at time when countries are most stable, and if that effect decreases as instability increases.

Finally, another research question *explores if the directly observable effect of age composition on homicide trends is conditional on the level of homicide of countries*. The rationale in support of this question is the same as the previous one. Generally, it seeks to explore if the observation of an effect of demographic forces can depend on the presence or absence of the other criminogenic forces that dictate the homicide trend in lieu of demographic shifts. Hence, in countries where homicide rates are highest (itself a consequence of the influence of other criminogenic forces), the effect of age may not be as apparent. In contrast, in the safest countries, where other criminogenic forces are less prevalent, demographic shifts may have the greatest impact in dictating the homicide trend. Hence, the presence of other criminogenic forces may itself be a source of heterogeneity in the effect of age composition.

The underlying premise of the latter two research questions and hypotheses is that the directly observable effect of age composition may be conditional on the absence of competing drivers of homicides.[17] This proposition is inspired by several empirical and theoretical developments of prior literature. First, by findings of the risk factor literature that the directly observable impact of an individual risk factor is contingent on the level of other risk factors competing for effect (Hannon, 2003; Kahlmeter et al., 2017; Raine, 2002). Second, by the absence of an observable relationship between age composition and homicide trends during the specific period of the crack epidemics in the United States – a relationship that become very apparent as soon as the epidemic receded. Finally, this proposition may serve as a potential explanation for why several of the most violent countries in the world are not participating in the International Homicide Decline.

Table 3.2 summarizes all above research questions and related hypotheses. These questions are unified by their focus of exploring the effect of population age on

[17] To be clear, the level of stability and the level of homicide are only two of many other plausible indicators for concentrated disadvantage at the country level. Theoretically, this same investigation could be conducted using other measure of disadvantage, assuming only that such measure would be particularly impactful for homicides, and that its effect would be extensive enough to generate effects for an entire country.

homicide trends more generally, and specifically to test their explanatory power of the international homicide decline. Subsequent chapters define how these questions were operationalized in measures and methods, the corresponding results and conclusions.

Table 3.2: Research Questions and Hypotheses

Research Question	Hypothesis
1. Is there an average effect of percent youth on homicide trends?	The average effect of percent youth on homicide rate is positive and above zero.
2. Are there variations in the impact of percent youth across regions?	The average effect of percent youth on homicide rate varies by region. Moreover, that effect is positive and above zero for the regions which experienced homicide declines.
3. Is the effect of percent youth on homicide trends conditional on the level of state fragility of countries?	The effect of age composition on homicide trends is conditional on the level of state fragility of countries. In particular, the effect of age is stronger for countries with lower levels of instability, and weakens gradually as country instability increases.
4. Is the effect of percent youth on homicide trends conditional on the level of homicide of countries?	The effect of age composition on homicide trends is conditional on the level of homicide of countries. In particular, the effect of age is stronger for countries with lower levels of homicide, and weakens gradually as homicide rates increase.

Through this research, I expect to directly address the contradiction between the theatrically expected effect of population age on homicide trends, with the effects actually observed by the empirical literature. While engaging in this debate, I also investigate the causes of the international homicide decline, and the reasons why only the safer countries in the world may be enjoying the pacifying influence of an aging of their populations.

Chapter 4: Data and Methods

Level of Analysis

The test of the relationship between age composition and homicide rates is a macro-level research question. It refers to the identification of trends and patterns in relation to an indicator that is observed at the level of populations, as opposed to individuals. Macro-level studies have a long tradition in Criminology, often as ecological perspectives that attempt to explain the behavior of individuals by their location, or the causes of the differences in the prevalence of crime across places (Pratt & Cullen, 2005). A few examples include the Chicago school and Social Disorganization Theory (Shaw & McKay, 1942), Strain and other theories of deprivation (Merton, 1938), Routine Activities Theory (Cohen & Felson, 1979), and Intuitional Anomie Theory (Messner & Rosenfeld, 1993).

A common challenge to macro-level research is the appropriateness of its level of analysis. Distinct from individual-level studies, macro-level research can utilize varying kinds of observations, ranging from the very distal level of countries and worldwide regions to more proximate units such as neighborhoods and street segments. Most often researchers attempt to match the level of analysis with what is most appropriate to address their research question. For instance, studies in policing in the United States often benefit most from investigations at the local level, which suited to identify local hot spots of crime and to guide the deployment of officers (Sherman et al., 1989). Moreover, a common restriction in research is the availability of data for certain levels. As mapping and telecommunication technology improved, so did the ability of researchers to identify the location of incidents with much greater precision - a trend that has fueled new developments in ecological studies of crime and criminal justice (Short, 1998; Weisburd, 2015).

The level of countries is one of the highest levels of aggregation found in criminological research. As such, it is inappropriate for the investigation of several research questions in criminology, particularly those pertaining to individual choice, and local level policies. Instead, most cross-national studies focus on identifying and understanding the relationship between macro-level social and economic indicators on crime rates, such as inequality, economic development, urbanization, unemployment, divorce rates, population density, and demographic composition (Koeppel et al., 2015; LaFree, 1999; Nivette, 2011; Trent & Pridemore, 2012).

The current study utilizes countries as its main unit of analysis. This choice is primarily justified by the fact that the current study seeks to explore changes in homicides rates that are being felt across countries internationally. As country level patterns, homicide trends are likely associated with factors within the same level of analysis. Moreover, if understood as an international phenomenon, the homicide decline may be a consequence of drivers with enough strength and scope to be observed and measured cross-nationally.

However, it should be clear that nothing about the relationship between demographic composition and homicides restricts its study to a specific level of analysis. Prior research has successfully analyzed data of the population by each age group for countries, states, cities, and even for lower levels of aggregation (LaFree, 1999; Phillips, 2006). Moreover, none of the theories that predict a relationship between age composition and crime are restricted to one particular level. The extrapolation of the individual association between age and criminality to greater levels of analysis, as posited within a Simple Aggregation perspective, is potentially applicable to any level. In addition, while the mechanisms of the control perspectives (e.g., Relative Cohort Size) speak about interactions between individuals, their macro-level implications should be felt very broadly, whenever variations exist in the demographic composition of a population.

Therefore, the country-level scope of the current study is motivated by the present research questions, in particular, the goal to investigate the drivers of the international homicide decline, and changes in the homicide rates of countries more broadly. Future studies should investigate if the relationships found in this research are also observable at lower levels of analysis. Moreover, if variations in effect exist across levels of analysis, empirical and theoretical developments should attempt at identifying, and explaining them.

Data Overview

The test of the hypotheses described in chapter 3 require data on homicide rates, population by age group, and on relevant control variables. Additionally, as the research questions seek to explore change, and to infer causality about trends over time, it is crucial that all data are available longitudinally, for as long a series as possible.

For that end, this study utilizes a combination of available sources with data at the country level. Traditionally, the collection and processing of country data at an international level have been carried out by international organizations, which are the entities with the political reach and the authority to lead this type of effort (LaFree, 1999). Furthermore, there are several cases of successful international data collection projects by independent academic researchers. Examples related to crime and criminal justice include the project “Violence and Crime in Cross-National Perspective, 1900-1974”, which collected data for 110 countries for a series of 75 years (Archer & Gartner, 1987). A second study by Bennett (2009) compiled and curated data from several sources into a centralized database with information about 52 countries for the years between 1960 and 1984. These projects provided substantial contributions to comparative criminological research, but they are no longer active. Outside of criminology, however, many academic projects still exist for collecting data at the cross-national level, particularly for indicators related to political matters, the environment, or the economy.

In some cases, these academic sources are more suitable for longitudinal research than alternative efforts by international organizations. Two of those data sources are used in this project for obtaining important control variables. The first is the Standardized World Income Inequality Database (SWIID), a project from the University of Iowa which contains what I consider the best currently available data on income inequality since 1960 (Solt, 2016). The second source is the Center of Systemic Peace, an organization that develops and publishes several indicators about politics, democracy, and peace for countries worldwide. Among these indicators is the State Fragility Index, which constitutes one of the few indicators on state stability and efficacy which is available for a longer time series, since 1995 (Marshall & Cole, 2009; Marshall & Elzinga-Marshall, 2017).

Specifically for indicators on crime and criminal justice, international organizations remain the institutions responsible for the most advanced projects for the collection and processing of data. In the past, the International Criminal Police Organization (INTERPOL) was the main source of cross-national data on crime and criminal justice, which was collected primarily through a survey of authorities of each member country (LaFree, 1999). While INTERPOL's data was one of the main sources used by comparative criminological research during many decades, this data collection project has been interrupted, and the data are no longer published by the organization (International Criminal Police Organization, 2018). At present, two other projects persist: the United Nations Survey on Crime Trends and the Operations of the Criminal Justice System (UN-CTS), which is the basis for the United Nations Homicide Data, and the World Health Organization Mortality Database.

Sources of Homicide Data

United Nations Homicide Data

The United Nations Homicide data are the consolidation of decades of efforts by the United Nations in collecting internationally standardized data on crime and criminal justice for each of the world's countries (United Nations Office on Drugs and Crime, 2014). Overall, the database corresponds to the systematic consolidation of data which is obtained independently from thousands of national and international sources, including the United Nations own archives, other international organizations, national statistical agencies, national police offices and national health agencies. All data collected is compiled into a larger dataset, where each data point is considered in regards to its quality, and to that observation's adequacy to the International

Classification of Crime for Statistical Purposes (ICCS). The ICCS is methodological instrument first developed by the United Nations Office on Drugs and Crime in 2015, presenting governments and other organizations with a set of coherent standards for defining and measuring crime and criminal justice outcomes.[18] A few examples include homicides, robberies, assaults, arrests, prosecutions, convictions and incarcerations. As a goal, the ICCS sought to detail strictly methodological definitions of several crime and criminal justice outcomes that are independent of the legal definitions of each particular country, providing the conceptual integrity necessary for the production statistics on crime and criminal justice indicators that are internationally comparable (United Nations Office on Drugs and Crime, 2015).

While the United Nations Homicide Data contains records from thousands of sources, most data are collected directly by the United Nations, through the Survey on Crime Trends and the Operations of Criminal Justice Systems (UN-CTS). The CTS is a yearly data collection effort, in which UN staff directly contacts officials from member countries requesting answers to a detailed survey with questions about crime and criminal justice statistics, in addition to information about the composition and the quality of each of those measures (United Nations Office on Drugs and Crime, 2017).

[18] In the United States, a committee of the National Academy of Science endorsed the ICCS as the model for the modernizing of national crime statistics (The National Academy of Sciences, Engineering, and Medicine, 2016).

The UN-CTS is an ongoing data collection effort with origins in the 1970s. Since then, UNODC staff have continuously engaged in efforts to improve the quality and the comparability of the data, mostly by defining standard methodological instruments (e.g. the ICCS), improving the strategy for data collection, establishing partnerships with local governments and authorities, and, in some cases, by directly helping countries build statistical capacity (United Nations Office on Drugs and Crime, 2017).

Between June of 2017 and July of 2018 I was a research consultant for the United Nations Office on Drugs and Crime, in Austria, where I was part of the team working on an update of the United Nations Homicide Data. That update was purported to support the 2019 edition of the Global Study on Homicides. In addition to organizing all CTS data within a coherent framework, we engaged in a comprehensive effort to find, collect and document historical data on homicides from external sources available globally. Subsequently, we utilized each of these sources to validate one-another, verifying if a same count of homicides was confirmed across multiple sources, and over time. In the case of homicides, this work is facilitated by the fact that each homicide death presumably generates two official records: once as a crime count in the criminal justice system, and a second time as a cause of death registered by the health system. As these are usually relatively independent systems, each with its efforts for identifying and classifying deaths, homicide statistics produced from criminal justice records can be used to validate counts obtained from the health system, and vice-versa.

The data validation process was a comprehensive effort to leverage all data collected in order to obtain the single best homicide count for each country and year globally, while ensuring the comparability of these statistics. For countries and years where no quality data were available, none was selected and values were simply left missing. For all other observations and sources, the UNODC team maintained the following considerations with regards to data quality (United Nations Office on Drugs and Crime, 2017):

1. The consistency of the data with a standardized definition of homicides, as mentioned in the ICCS.
2. The presence of a clear documentation detailing the source and the methodology associated with collecting the data;
3. The presence of more data observations, and the coherence of each of those observations with each other. Longer series of data from the same source which were robust, and without any artificial breaks were generally considered better then single data points. In addition, sources with data on victims by sex, by age group and on other disaggregation which were consistent with the total homicide count were an indicator for quality.
4. If there was a clear indication that homicide data covered information about all homicides in the country. For instance, if data exclude a particular geographical territory, or records from a particular police organization.
5. The specific counting rule used in collecting the data, if homicides reflected the number of homicide victims, as opposed to cases, offenses or investigations.

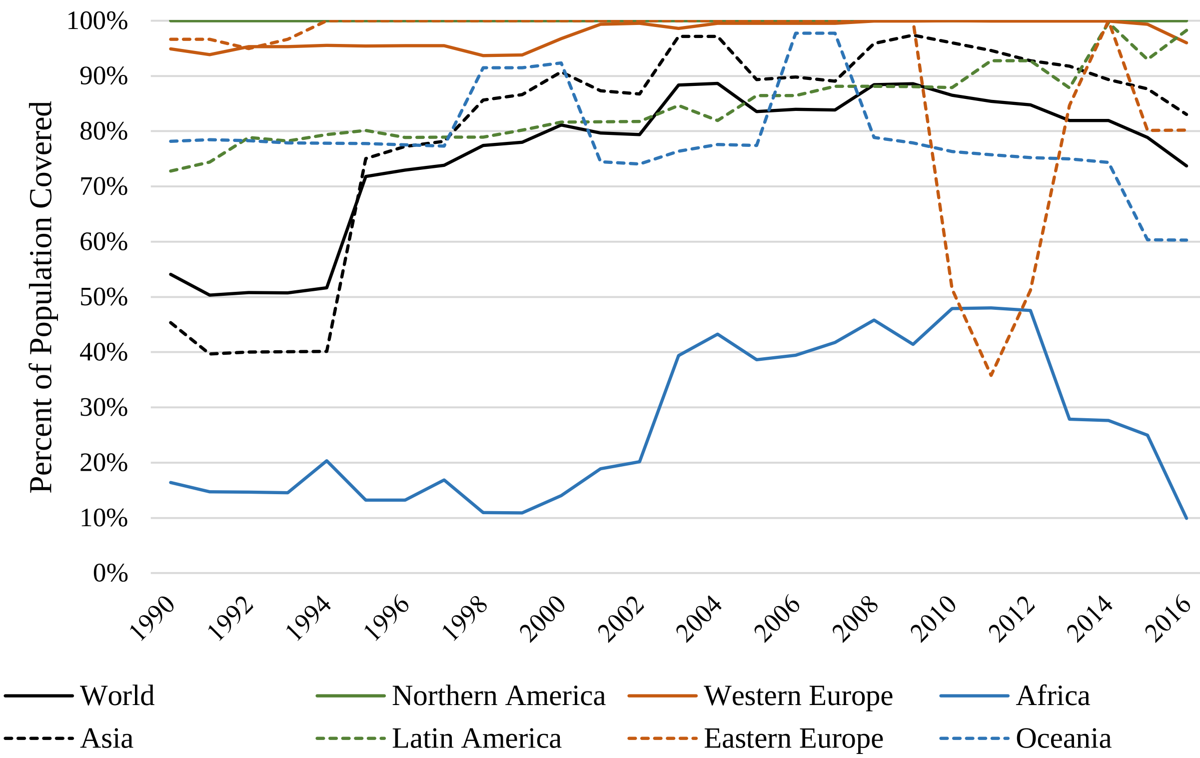
6. If the primary source of data constituted an official governmental institution, or an otherwise credible source of country-level data.
7. Each country's government is given the opportunity to revise homicide statistics prior to publication, when they are requested to correct any inaccuracies, or to clarify any remaining issues. Any new data submitted by countries at this stage goes through all the same validation steps as mentioned above, and may still be excluded from publication, if they are not deemed valid.

The expertise of UN's staff, and the relationships between the UN and member countries were invaluable at considering specificities of each country, and at clarifying particularities that invalidate some of the homicide data we collected. An interesting example is the case of India, a country where homicide statistics were excellent, but incompatible with the ICCS definition of homicides without the inclusion of dowry-related deaths, a category of killings that increases the homicide rate of India by almost 25%.

Our primary goals in this version of the United Nations Homicide Data were two-fold. First, we sought to achieve global coverage of the total count of homicides. Ultimately, we were able to obtain at least one year of data for 197 countries globally, encompassing 92.5% of the World's population in 2015. Second, we aimed at constructing a robust longitudinal dataset ranging from 1990 to 2016. Though the availability of longitudinal data varied greatly by country, we were able to construct a complete series of 27 years for 43 countries. The conclusion of this work is the most comprehensive dataset on homicides available to date, with data on victims by sex, by age, by the mechanism of killing, by situational context, among other indicators related to homicide victims and perpetrators.

Figure 4.1 presents the proportion of the population of each region and of the world with data on total homicides since 1990. The single region where data are still missing for most of the population in Africa, where issues related to data quality are prevalent. Around 74% of the World’s population is covered in the data in 2016, including some of the world’s most populous countries in Asia. Data availability peaked at 88% in 2009. The decline thereof is explained by the time lag in reporting for some countries, some of which spend years to produce and to publish statistics on homicides. The regions of Northern America, Western Europe, and Eastern Europe are not visible in the graph for some years, simply because their coverage is capped at 100% of the population. Eastern Europe has a single gap in coverage around 2011, which is explained by the lack of data for Russia around that time. Finally, there is a general trend of increase in data availability since 1990.

Figure 4.1: Percent of Population Living in Countries with Available Data per Region and Year



Source: United Nations Office on Drugs and Crime

World Health Organization Mortality Database

The Mortality Database of the World Health Organization (WHO) is a systematic compilation of medically certified deaths of countries worldwide. As part of a yearly data collection, the WHO contacts authorities of member countries requesting mortality data. In turn, countries routinely submit their data through established methodological instruments and channels of communication (World Health Organization, 2018).

The WHO Mortality database is a very traditional source of medical data, currently including more than two billion death records over seven decades since 1950.

Over this time, the Mortality Database has become an invaluable source for the study of trends and country-level predictors of mortality across fields.

Mortality records submitted to the Mortality Database are aggregated according to their medically registered cause, which is classified according to a globally standardized International Classification of Diseases (ICD). The ICD itself has a very long history, with origins in the late 19th century as an international list for classifying causes of death (World Health Organization, 2014). Since that time, the ICD has had multiple version and revisions (World Health Organization, 2018). Data currently in the mortality database includes records reported using versions 7 through 10 of the ICD.

The ICD and the Mortality Database include a very specific categorization for deaths caused by homicides. For that reason, the WHO is a well-established source of homicide data for comparative criminological research, which has relied on the database for the calculation of homicide rates that are comparable cross-nationally, and that are reliable over time (Koeppel et al., 2015). There are, of course, a range of issues and challenged related to the quality of homicide data in the Mortality Database. In particular, past research has raised concerns related to the underreporting of deaths, caused either by the lack of coverage of national health systems, or by the inability of some governments to consolidate data about these deaths (Andersson & Kazemian, 2018; Bennett & Lynch, 1990), sometimes intentionally (Lysova, 2012). While I believe the impact of those issues are often exaggerated, in actuality the exact precision of the homicide statistics of the WHO is difficult to access and to audit. Still, despite such challenges, the WHO engages in active efforts to increase the comparability and reliability of reported data through several of the same methods as the UNODC in regards to their homicide data. These efforts include direct partnerships and field work, focused at building capacity for the record of vital statistics, the comparison between reported counts with other reliable sources of data, the comparison with values from other countries with similar characteristics, and the longitudinal robustness of reported counts (World Health Organization, 2013). While there is never a way to be certain of the quality of WHO homicide counts, there are several indicators for quality. First, in terms of substantive validity, there are no surprises in the data. Countries which are known for their high levels of violence in Latin America and Africa do display higher rates of homicides, while countries are known for their safety in Eastern Europe, Oceania and Southeast Asia are also the ones with the lowest levels of homicides in published data (World Health Organization, 2013). Second, while the reporting of data are done independently, neighboring countries are very likely to have similar rates of homicides. Finally, longitudinal trends for a number of countries are robust for a very long series of more than half a century, particularly for a smaller sample of developed democracies. For some of these reasons, WHO data are often regarded as the best cross-national source of data on homicides, particularly for longer-term longitudinal analyses (Andersson & Kazemian, 2018; LaFree, 1999).

In parallel to the Mortality Database, the WHO also elaborates and publishes estimated homicide counts for countries without actual observable data on homicides. These estimates are generated using a regression model, which takes advantage of the association between homicides and other social indicators to estimate homicide counts based on other known characteristics of a country. These characteristics include countries' infant mortality rate, Gini index, the size of the urban population, HIV prevalence, alcohol drinking prevalence, among other indicators (World Health Organization, 2014).

As these estimates are produced using common predictors of homicides, they are inadequate for the identification of the associations between homicide rates and macro-level indicators. In the past, several cross-national studies, possibly inadvertently, utilized versions of the WHO Homicide data that included model-based estimates, an issue that was noted by recent literature (Kanis et al., 2017). The current study draws its homicide statistics directly from the WHO Mortality Database, which does not include model-based estimates, or any other transformed data besides the raw counts submitted by member countries.

Measures

Homicide Rate

The availability of comparable, high quality and longitudinal data on homicides is the main challenge for the execution of this project. Previous research has often contrasted the UN Homicide Statistics with the WHO Mortality Database (Kalish, 1988; LaFree & Drass, 2002; Tuttle, 2018). Generally, WHO data has been considered a superior source, an assessment justified by the fact that medical records constitute actual counts of diseased persons, which are not as subject to the subjectivity of the recording person, to the personal bias of criminal justice employees, or to the legal definitions of individual countries. Moreover, as WHO statistics are based on the ICD, which has a very long tradition in the medical field, criminologists often attribute a greater level of conceptual validity to WHO statistics than to other sources (LaFree et al., 2015; Rogers & Pridemore, 2013).

Most claims on the superiority of the WHO homicide statistics over other sources rely on the fact that extant research has shown the same preference. Therefore, it has somewhat became agreed upon that WHO homicide values are better, even though very little research has actually put this convention to test (Rennó Santos & Testa, 2018). The first study by Bennett and Lynch, published in 1990, compared homicide data of 31 countries collected from United Nations, the World Health Organization and Interpol. The authors concluded that while some differences in the values existed across sources, analysis using each of them yielded largely similar results. More recently, a second study by Andersson and Kazemian (2017) again compared UN and WHO homicide statistics using data from 1998 to 2010, finding that both provided reliable measures of homicides, and produced very similar results in statistical analyses of predictors of homicides. Finally, the authors concluded that while the United Nations Homicide Statistics contained a more robust cross-sectional measure of homicides, the WHO data was more suitable for longitudinal analyses over longer series.

While some of the past research has compared and contrasted the WHO and the UN in search of the "best" international data on homicides, I propose instead that both sources, as they currently stand, may be best used in combination. To be clear, I do not believe this combination was possible in the past. Indeed, while the WHO have always relied on the International Classification of Diseases (ICD) to provide conceptual integrity to their international data collection, it was only recently that the

UNODC developed and introduced the International Classification of Crimes for Statistical Purposes (ICCS; United Nations Office on Drugs and Crime, 2015).

Unsurprisingly, the definition on homicide in the ICD and in the ICCS are largely consistent. According to the ICD-10, a homicide is defined as any death directly resulting from an injury inflicted by a second person, who had the intent to injure or the kill the victim. That definition explicitly excludes suicides, as another person must have caused the death. In addition, deaths caused by legal intervention, or as a consequence of an operation of war between two states, are not included in this classification. Codes X85 to Y09 of the ICD-10 detail multiple mechanism and contexts of the homicide killing, such as killings committed by firearms, or deaths resulting from neglect, or some form of maltreatment from parents or partners (World Health Organization, 2010). Though many countries are unable to provide that level of detail regarding their deaths, particularly the countries unable to clarify the specific circumstance surrounding each homicide, the categories are present, and do provide interesting data for future analyses. In addition, code Y87.1 includes deaths caused by sequelae of assault, which were included in the homicide counts of the current study.

According to the International Classification of Crime for Statistical Purposes, a homicide is any death that is unlawfully inflicted to a person, by a person who had the intent to cause death or serious injury. This definition includes three main criteria for classifying a killing as a homicide. First, the objective criterion holds that a person needs to have caused the death of another person. Second, the subjective criterion holds that the killing needs to be intentional, which excludes manslaughter and any kind of accidental killing. Finally, the legal criterion holds that the killing needs to be unlawful, which excludes deaths from legal interventions of law enforcement, or from legitimate operations of war (United Nations Office on Drugs and Crime, 2015).

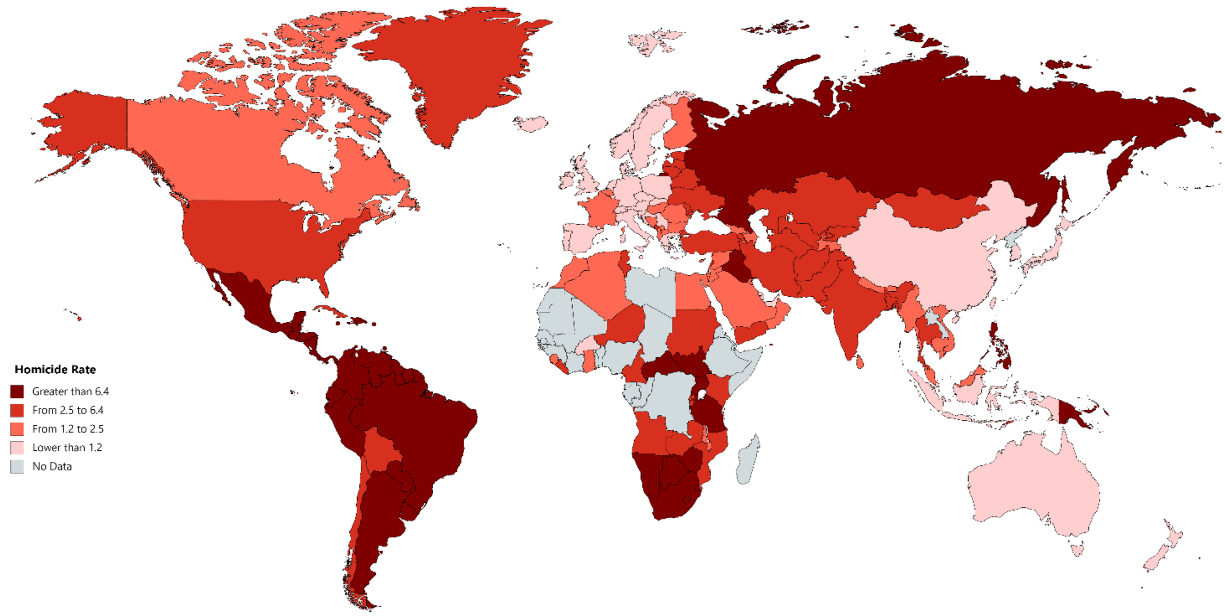
The definition of homicides from the ICD and the ICCS are not only compatible, they are virtually the same. The similarity is likely intentional, as it ensures that counts obtained from one organization are useful to the other. A distinction exists, however, on the primary source of each database. While the WHO generally focused their data collection efforts on the health system of member countries, the UNODC prefers instead records obtained and classified by law enforcement authorities. The argument behind this methodological decision by the UNODC is that, ideally, the investigation effort by criminal justice authorities would best clarify the compatibility of each death with the three criteria listed in the ICCS. The rationale is that police officers would be much more effective at defining the legality and the intentionality of a killing than medical professionals who have little contact with offenders (United Nations Office on Drugs and Crime, 2014). It is true that WHO homicide counts have a tendency to be slightly greater then UN homicide counts, sometimes because of the counting of killings that produce a body, but that are neither intentional nor illegal (World Health Organization, 2014). However, the reality is that most killings worldwide are not the subject of enough investigative work to define their intentionality or legality with some amount of certainty.

Moreover, many of recent developments in international data collection and validation have rendered the comparison between the Mortality Database and the UN Homicide Statistics much less relevant than it once was. Both the UN and the WHO make use of the other organization’s data to validate their own values, and even to fill gaps in their own series (United Nations Office on Drugs and Crime, 2013; World Health Organization, 2014). While each organization generally prefer their own primary data to external sources, they also recognize the value, and leverage the complementarity of each other's statistics. I argue that academic researchers should do the same.

The United Nations Office on Drugs and Crime has continuously developed and introduced new standards of data collection, quality assessment and verification in more recent versions of their data, overcoming many of the concerns raised in past research (United Nations Office on Drugs and Crime, 2017). In addition, because of the greater focus on homicides specifically, in contrast to a larger concern over several causes of mortality, the UNODC is able to specialize, and to dedicate a much greater amount of resources to clarify each data point, and to fill existing gaps in data through external searchers. Partially for that reason, the 2018 edition of the United Nations Homicide Statistics currently contain the best international data on homicides from 1990 to 2016. That assessment is supported by all methodological developments the UNODC has carried out in their homicide statistics in recent decade, a result of decades of consistent data collection (United Nations Office on Drugs and Crime, 2018). That type of stability is ideal to support the collection of high-quality data longitudinally. More importantly, however, is the fact that UNODC staff collected and considered each of the homicide counts in the WHO Mortality Database while developing their own official series for each country. Any data point from the WHO Mortality Database that was not used by the UNODC since 1990 was either considered inferior to the count of another source, or was notably found to be inaccurate.

Figure 4.2 is a world map illustrating the latest available homicide rate of each country or territory with available data. From 234 countries listed in the United Nations Homicide Statistics, data are available for at least one year for 197 countries. Together, these countries hosted 92.5% of the World's population in 2015. Overall, data are available for virtually the entire world, with the single exception of parts of Africa, where issues of data availability remain.

Figure 4.2: World Map of Homicide Rates



Note: The map is an illustration and makes no political statement. Some countries or entities are too small to be visible in the map. The source for the data is the United Nations Office on Drugs and Crime.

The map also displays some interesting geographical patterns in homicide rates. Generally, countries are very likely to display similar homicide rates as their neighbors. Homicide rates are the highest in Latin America, sub-Saharan Africa, and in Russia. In Brazil, homicide rates per 100,000 population were at 29.5 in 2016, at

33.9 in South Africa, and at 10.8 in Russia. Europe tends to display progressively lower homicide rates from East to West, where countries such as Portugal and Spain have a homicide rate of around 0.65 per 100,000 individuals -- some of the lowest of the World. Similar rates are found in Southeast Asia and Oceania, where South Korea had a homicide rate of 0.7, and Australia had a rate of 0.94. As these statistics illustrate, there are immense disparities in homicide rates across the World. While in 2015 the homicide rate of Singapore was of 0.25 per 100,000 population and the rate of Japan was of 0.28, in Honduras that same rate was more than 200 times greater, at 57.5, and more than 370 times greater in El Salvador, where the rate was at 105.4.

Combined Homicide Series

Currently, the UN Homicide Statistics provide the best data on homicides from 1990 to 2016, at least in terms of coverage. Although that period corresponds to a rather long series of 27 years, that time-frame fails to capture much of the variance in age composition which was experienced by many countries over the second half of the 20th century. That is particularly the case for the aging of baby-boomers, as someone born immediately after World War would already be 44 years old by 1990.

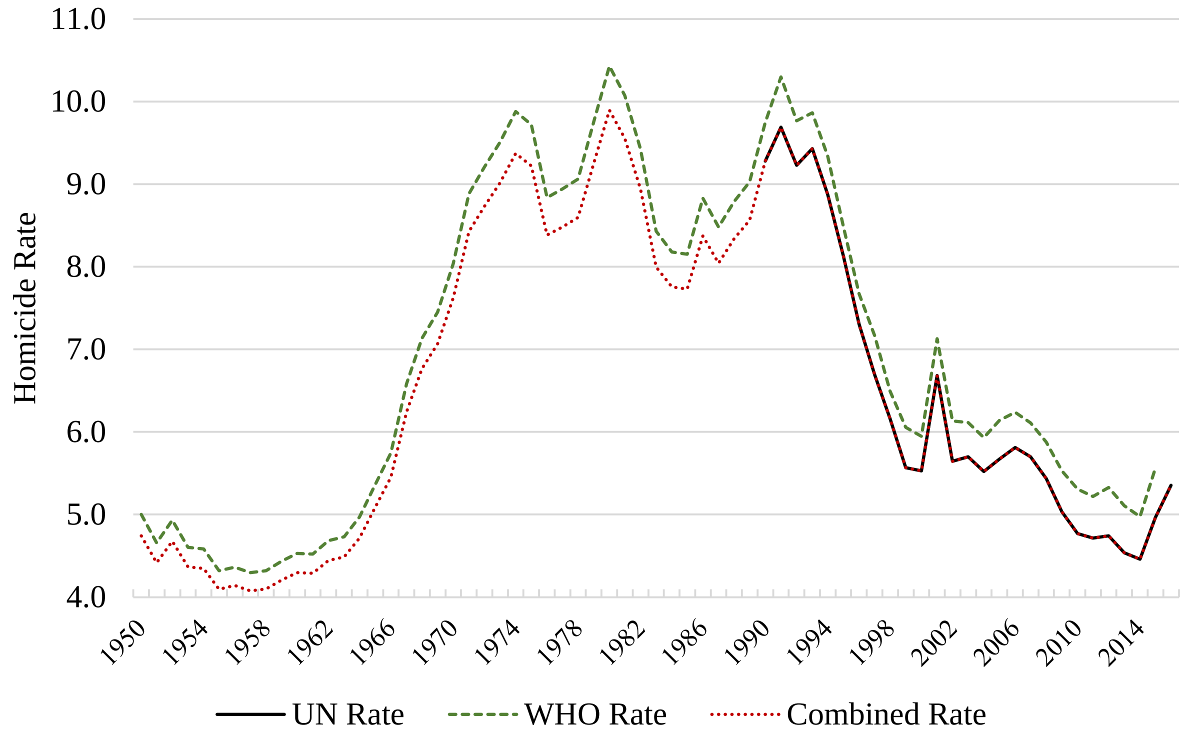
For a selected sample of countries, the WHO Mortality Database contains robust data on homicides for a very long series, at times since 1960 or 1950. Moreover, a sub-sample of these countries display largely consistent trends in homicide rates between the WHO and the UN statistics. Taking advantage of this consistency, for the cases where I found both series to be complementary, I extended the homicide series of the UN Homicide Statistics using data from the WHO from before 1990.

That operation was performed only for the countries that met the following specific set of hard criteria, which considered the degree of similarity between the homicide series in the WHO and in the UN homicide data.

1. If, on average, the homicide rate of the WHO was between 0.7 and 1.3 times the UN homicide rate between 1990 and 1993;
2. If the Pearson correlation between the UN and the WHO series across overlapping years was above 0.6;
3. If there was a direct continuation between WHO data in the late 1980s and UN data in the early 1990s, without a gap with missing data in that period.
4. If the country had more than 1,000,000 inhabitants in 2016.

For countries that met those restrictions, I produced a series of homicide which included UN data since 1990, combined with available WHO data from 1950 to 1989. In addition, for each country, WHO data were adjusted by the average ratio between the WHO and the UN series between 1990 and 1993. The following figure illustrates the resulting combined series in comparison to the original UN and WHO rates using data for the United States. For this country, the WHO homicide rate is 5% greater than the UN homicide rate, a difference that is more or less consistent over all overlapping years between both series. Moreover, both the WHO and the UN homicide rates have the same trends over time, which is reflected in a Pearson correlation of 0.997 between both series. The dotted red line corresponds to the final combined rate, which reflects the UNODC rate from 1990 to 2016, combined with the WHO rate from 1950 to 1989 adjusted by 5%. This adjustment ensured a smooth continuation in the combined series, which runs for 67 years between 1950 and 2016.

Figure 4.3: United States Combined Homicide Rate Series



Source: United Nations Office on Drugs and Crime / World Health Organization

The same operation was performed for the other 30 countries which met the above restrictions, in addition to the United States. Appendix A contains the figures with the combined series for each of those 30 countries. Those figures were used to visually inspect the adequacy of the method and of the criteria described above for each individual country.

Among all 31 countries for which combined series were produced, the Pearson correlation between the UN and WHO rates in overlapping years between 1990 and 2015 is 0.986. Such a high correlation illustrates the strong compatibility between the UNODC and the WHO homicide statistics. Consequently, analyses using the WHO homicide rate in lieu of the combined homicide series yield very similar results. These additional analyses were performed to test the sensitivity of results to the use of long-term data from the WHO, instead of the combined series, and are presented in Chapter 5.

Samples

The United Nations Homicide statistics list a total of 234 countries and entities, which together host the world's entire population. At least one year of homicide data are available for 197 countries. Of those, 59 are smaller states with less than 1 million inhabitants, which are primarily territories of other countries. Because of their size, these entities are usually inadequate for cross-national statistical analyses, as they often do not have enough homicides to support a trend above zero, and as any existing trends are too volatile over time. In addition, taken together these entities had only 17,037,097 residents in 2016, which corresponds to 0.23% of the world population in that same year.

Excluding smaller states, the remaining analytical sample has 138 countries. The UN data for that sample contains a total of 2,558 counts of homicide. This constitutes the first analytical sample of the current study, which is designated the "High Coverage Sample." This sample covers all years from 1990 to 2016, and only utilizes UN data. This sample is characterized by its reliability and coverage, as all data are originated from the same source, and as they include a very diverse sample of countries across regions worldwide. To be clear, such a coverage is unprecedented in other cross-national studies without the use of artificial model-based data (Kanis et al., 2017; Nivette, 2011).

A second sample, designated as the “Long Series Sample”, utilizes the series produced using combined WHO and UN data. From the 31 countries for which combined data was produced, 26 had homicide data stating from 1960. Those 26 countries were selected as components of the Long Series Sample. The year of 1960 was selected as the starting year of that sample because it corresponded to the earlier year for which a sizable sample of countries with homicide data was available. In contrast, only 7 countries have homicide records since 1950. In addition, several control variables used in this study are only available since 1960. Although this sample does have countries from almost all regions in the world, the sample is composed primarily of higher-income and stable democracies. Therefore, while this sample includes most of the countries that are typically included in extant cross-national literature (Trent & Pridemore, 2012), it does not correspond to a general picture of the globe. Instead, the purpose of this sample is to observe variations in effect across a very long time series, which encompasses a period when these countries experienced extensive variation in their demographic compositions and in their homicide rates.

Countries included in each of the two analytical sample (Long Series, and High Coverage) are listed in Appendix B. Appendix C lists countries that were excluded from the samples because of their size, and because they did not contain available data on homicides. The appendices also include summary statistics of data availability by country, including the number of years with available data, the earlier year available, the later year available, in addition to the average, the standard deviation, the minimum and the maximum of the homicide rate of each country.

Percent aged 15 to 29

Quality data on population counts serve two purposes in this project. First, data on total population is the denominator in the formula used for calculating homicide rates. Second, disaggregated population counts by age group are necessary for the description of the age composition of each country over time.

Almost all data on population counts used in this project is sourced from the 2017 Revision of the World Population Prospects (WPP), a longstanding project of the Population Division of the United Nations (United Nations Population Division, 2018). Similar to the UN Homicide Statistics, the WPP is a multisource project in which a team collects data from a number of country-level sources, which are curated and processed into counts for each country-year. Most WPP data are sourced directly from member countries' official records, which are derived primarily from population census conducted periodically be governments worldwide. When such quality data are unavailable, the UN Population Division relies on alternative sources of data and on estimates (United Nations Population Division, 2018).

Data on total population is available for almost all countries globally, for between the years of 1950 to 2015. The single exception is Kosovo, a country that declared its independence from Serbia relatively recently, in 2008. Population data for Kosovo was collected directly from the UN Homicide Statistics. Data on population by sex and by age group is only missing for Kosovo and 32 other entities, which are mostly Island States or otherwise small nations in the Pacific Ocean and in Europe. In addition to Kosovo, South Sudan and Central African Republic are the only two countries with more than 1,000,000 residents that had available data on total population, but no data on population by sex or age group.[19]

Another notable omission is the year of 2016, for which there is available data on homicides, but no data on population by age group, for any countries. Because of that omission, data for the year of 2016 is not included in many of the subsequent analyses.

The main independent variable of the current study is the percent of the total population of each country-year which is between 15 and 29 years of age. That measure was calculated by dividing the population between 15 and 29 years, over the sum of the population recorded in all age ranges. The resulting proportion was multiplied by 100. In this current study, this measure is referred to as the percent 15 to 29, the percent young, or the percent youth. The variable serves as a measure of the proportion of a population that is close to the peak age of involvement with violent offending.

In the current study I utilize the percent of the population aged 15 to 29 as a measure of the percent of the population that is young. Several reasons motivated the

[19] Countries without data on population by age group include: American Samoa, Andorra, Anguilla, Bermuda, Bonaire, Sint Eustatius and Saba, British Virgin Islands, Cayman Islands, Cook Islands, Dominica, Falkland Islands (Malvinas), Faroe Islands, Gibraltar, Greenland, Holy See, Isle of Man, Kosovo, Liechtenstein, Marshall Islands, Monaco, Montserrat, Nauru, Niue, Northern Mariana Islands, Palau, Saint Helena, Saint Kitts and Nevis, Saint Pierre and Miquelon, San Marino, Sint Maarten (Dutch part), Tokelau, Turks and Caicos Islands, Tuvalu, Wallis and Futuna Islands.

use of that particular age-range. Several studies in the criminological literature have also used the percent of the population aged 15 to 24 years of age (Rogers & Pridemore, 2015). For the current study, the selection a broader age range was preferred over more restricted age ranges, as it may accommodate variations in peak age of criminal involvement across countries. While it is not the focus of this study to explore such differences, recent research has found interesting differences in the age and crime curve of countries (Steffensmeier et al., 2018), particularly in lower-violence countries in Asia with collectivist cultural settings, which tend to display a peak of violent involvement at a higher age than in the United States. A broader age-range that covers later years should be more adequate to accommodate these types of variations, which may be frequent in comparative research.

Furthermore, any age-range selected should yield percentages that would be very highly correlated with the percentages of almost any other age-range in close proximity. Countries with a very high proportion of their populations between 15 to 24 years are very likely to be the same countries with a very high proportion of their population between 15 to 29 years of age. Therefore, results from analyses using any of these measures should likely produce similar results.

In order to investigate this proposition, I also collected data on the population between 15 and 24 years of age, and on the population who is male and between 15 to 29 years of age. Both measures were obtained from the United Nations World Population Prospects. Both measures were divided by the total population size, in order to obtain the proportion of individuals in each country and year who are between 15 to 24 years of age, and the proportion of individuals who are, at the same time, males and between 15 to 29 years of age. To facilitate the interpretation, all measures of proportion were multiplied by 100, and represent the percent of the population at a certain age range.

Across the entire sample of countries and years, the Pearson correlation between the percent of the population between 15 and 24 years of age, and the percent of the population between 15 and 29 years of age was of 0.924, and between the percent of the population who is male and between 15 to 29 years, with the percent of the population between 15 to 29 years is of 0.906. Both are very high correlations. Additional analyses were conducted to test the sensitivity of findings to the choice between each of these measures of percent youth on homicide trends.

Finally, two additional measure of age composition were based on the Relative Cohort Size literature. The first measure corresponds to the ratio between the populations between the ages of 15 to 29 years, over the population between 30 to 59 years of age. The second measure is the ratio between the population ages 15 to 24, over the population ages 25 to 59.[20] To facility the interpretation of coefficients, both ratios were multiplied by 100. Analyses were also replicated using each of these measures of population age, in order to test their efficacy in predicting homicide trends.

[20] Models were also produced using the ratio of individuals between 15 to 29 years of age over all age groups above 30, and using the number of individuals between 15 to 24 years over all older age groups. Results did not change substantially.

The Pearson correlation between the original percent of the (total) population between 15 to 29 years of age and the first measure described equals 0.738, and with second measure it equals 0.669. Both correlations are high, but not nearly as high as the correlation between all three percentages which were calculated relative to the total population. Nonetheless, the correlations are indicative that the measures are not as distinct conceptually. The percent of the population between ages 15 to 29 over the total population is also a relative measure of cohort size, with the single difference that its denominator corresponds to the entire population, instead of a second specific age group.

To be clear, there are innumerous ways how *Relative Cohort Size* studies were operationalized and tested, each in line with the inquires and propositions of specific research questions and objectives. The current study draws from the original measures proposed by Easterlin (1978) and others (Macunovich, 2000; Pampel, 1993) by comparing the size of the youth age group over the size of older cohorts until age 60.[21]

Control Variables

The selection of control variables in the current study was largely restricted by a trade-off related to data availability. To be sure, that is a common issue for extant

[21] Originally, Easterlin (1978) defined relative cohort size as the ratio between persons between 15 to 29 years of age over the number of persons between 30 to 64 years.

comparative research, or for studies that deal with missing data more generally (Allison, 2002; LaFree, 1999; Nivette, 2011). On one side, there is the need to include relevant macro-level control variables in order to minimize the risk of omitted variable bias in regression analyses. In the other side, because of missing data, the addition of more control variables invariably reduces the number of available countries and years, often biasing the sample toward higher income and more stable countries which usually have better data. That issue is aggravated in the present study because of the use of a very long series of data, including years which may not contain data on a range of relevant macro-level indicators. In reality, measures for many of the theories hypothesized to have caused the 1990's homicide decline (Tcherni-Buzzeo, 2019) are simply not available for a broader set of countries beyond the United States and Western Europe. While there is indeed a risk of omitted variable bias in the results, the current study's goal of producing estimates that are applicable globally and longitudinally, in addition to the focus on the effect of age composition (and not on other proposed explanations) directs the present investigation to the use of a smaller set of controls with increased data quality. Moreover, some relief comes from the fact that cross-national predictors of homicides have a tendency to be very highly related with one-another, to the extent that studies can efficiently combine multiple measures of development, broadly defined both socially and economically, into a single variable (Pridemore, 2008, 2011; Testa et al., 2018). Therefore, several omitted controls may be closely related with observed measures included in the analyses. Moreover, the analytical strategy was designed to minimize the risk of omitted variable bias, and sensitivity analyses were performed to access the potential impact of omitted variables on the results.

Until very recently, country-level data on economic and social indicators were scattered across sources internationally, were often very difficult to collect, and were not necessarily comparable. The World Bank Open Data (formerly named the World Development Indicators), sought to address that problem by assembling a central repository which has establish itself as the main source of high-quality data for thousands of indicators. The repository is essentially a compilation of data sources from national statistical agencies, international organizations, and other institutions, which are curated by the World Bank's staff (World Bank, 2018).

As a priority, the present study focused on obtaining data on indicators that had a high sample available for many years. Two indicators were collected from the World Bank Open data. The first is the *Gross Domestic Product (GDP) per capita*, which corresponds to the aggregated value of all goods and services produced, divided by the population of a country in a given year. That indicator often serves as a measure of a country's wealth and aggregated economic well-being (Nivette, 2011; Trent and Pridemore, 2012). Most research hypothesizes a negative relation between GDP and homicides, often linking increases in wealth with a decrease in the harmful consequences of deprivation, and with an increase in the resources available for public institutions to address social problems (Fajnzylber et al., 2002; LaFree, 1998; Messner and Rosenfeld, 1997; Nivette and Eisner, 2013, Rogers and Pridemore, 2013, 2017). To account for differences in the pricing of the same goods (e.g. inflation, exchange rates), all values were adjusted to reflect their corresponding purchasing power in dollars in 2010. Therefore, all GDP counts correspond to their value as 2010 US dollars. Finally, to facilitate the reading of coefficients, values were transformed from a scale of $1 to a scale of $1,000.

The second indicator collected from the World Data is the *urban population*, measured as a percentage relative to the total resident population in each country. One interesting particularity of the percent urban is the almost liner increasing trend in that proportion, which rarely never declines over time in any country (World Bank, 2018). While that increase reflects improvements in productivity and other technological advancements, urbanization may also be a source of social disorganization and of other forms of social disruption, such as changes in routine activities and reductions in social control which may be criminogenic (Cohen & Felson, 1979; Lodhi & Tilly, 1973; Nivette, 2011). As the GDP per capita, the percent urban is also one of the most commonly used measures in cross-national analyses (Nivette, 2011; Trent & Pridemore, 2012).

Another commonly used indicator in cross-national analyses, and one of the strongest predictors of the difference in homicides between countries, is *income inequality* (Nivette, 2011). Income inequality is often understood as a cause of relative deprivation, which refers to the frustration steaming from the lack of legitimate means to obtain, or to achieve something that is available to others in the same society, and that is highly valued by its members (LaFree, 1999; Merton, 1938). Faced with this source of stain, some individuals may choose crime and violence as an illegitimate strategy for achieving success, or as a copying mechanism against a social structure which those individuals may feel is illegitimate, and operating against their best interest (Cloward & Ohlin, 1960; Wilkinson, 2004). While there are several available measures of income inequality, the Gini Index is one of the most popular and more easily available (Nivette, 2011). The indicator is a statistical measure of distribution, ranging from a hypothetical zero where there is perfect equality in the income of a population, to maximum value of 1 where there is perfect inequality. The World Bank contains data for the Gini index, but data on this indicator is largely missing for many countries and years. Fortunately, an alternative source is maintained by Dr. Frederick Solt, from the University of Iowa, entitled the The Standardized World Income Inequality Database (SWIID). That databased contains quality data on the Gini for at least one year for 189 countries. Though the longitudinal availability of these data varies, 22 countries have Gini data available for more than 50 years since 1960.

The *percent of the population that is male* was collected from the United Nations World Population Prospects. Similar to the percent young, the percent male is hypothesized to result in an increase in homicides though an increase in the availability of motivated offenders. While the percent male is a common measure included in cross-national analyses of homicides, estimated effects vary in strength and even in direction (LaFree, 1999; Trent & Pridemore, 2012). There is some debate on the cause of such inconsistency (Lim et al., 2005; Pridemore, 2011), and one potential explanation is reciprocal causality, as an imbalance in the proportion of the population in each sex may itself be a consequence of high levels of mortality due to external causes, including homicides (Hesketh, 2006). Future research can explore this issue further.

A last measure used in the current study is the State Fragility Index developed and published by the Center for Systemic Peace (2018). This indicator is a composite index which summarizes several measures of state effectiveness and legitimacy within the realms of security[22], politics, the economy, and social well-being. Each of the index's components are ranked to reflect the level of fragility associated with that particular area, ranging from a score of 0, for no fragility, to a score of 4 for extreme fragility. The resulting scores are then added together to produce the total State Fragility Index, which varies from 0 to 25. Ultimately, the score seeks to provide a summary measure of a state's ability to address crises, conflicts and social problems by effectively intervening where necessary (through policy and service), and by maintaining systemic peace and stability towards development.

While there are other indicators on country-level stability that are publically available, the State Fragility Index is the only variable found that is of good quality, and which is available for a longer longitudinal series. In total, this State Fragility Index is available for 167 countries for all years between 1995 to 2017. Since the indicator is not available for before 1990, this variable was only analyzed using the High Coverage sample.

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[22] The security component refers to a country's involvement in wars and to the degree of repression which is employed by a state toward its residents. The component does not summarize any indicators of crime or violence that would make it an inadequate predictor of homicides.

Data Availability

A total of 160 countries worldwide had populations greater than 1,000,000 individuals in 2015. Considering all years from 1950 to 2016, that would result in a maximum hypothetical sample of 10,720 country/years (160 times 67). As indicated by Table 4.1, data for population by age group and for the population by sex is available for nearly that entire sample. Other indicators, however, are much less available. The homicide rate is the variable with the least amount of observations, which is particularly the case due to the lack of observations before 1990 for nearly all countries, besides the sub-sample that met the restriction criteria for the combination between the WHO and the UNODC homicide rates. All economic indicators are only available since 1960, and the State Fragility Index is only available since 1995. Most indicators are only available until 2015.

On average, countries of the world have a homicide rate of 7 per 100,000 inhabitants, have 25.6% of the population between 15 to 29 years of age, have 49.8% of their population who are male, have a Gini index of 38, a GDP per capita (in 2010 US$) of $9,580,00, 48% of their population living in urban settings, and a State Fragility Index of 9.3. Moreover, there is immense disparity in each of the above indicators, particularly in the Homicide Rate, and in the GDP per capita. Ireland had the world lowest rate in the data, at just 0.07 per 100,000 individuals, while the highest homicide rate was recorded in El Salvador, in 1996, at 142.16. The world's lowest GDP per capita between 1960 and 2015 was recorded in Liberia in 1995, at just $120 dollars per person over that entire year. In contrast, the United Arab Emirates recorded an adjusted GDP per capita of $113.680,00 in 1980.

Table 4.1: Data Availability by Indicator

Statistic	N	Mean	SD	Min	Pctl(25)	Pctl(75)	Max	Earliest	Latest
Homicide Rate	3,671	7.00	11.86	0.07	1.15	7.75	142.16	1950	2016
Percent 15 to 29	10,362	25.62	3.01	14.68	23.91	27.50	38.15	1950	2015
% 15-24	10,362	17.95	2.54	9.34	16.41	19.64	26.21	1950	2015
% Male 15-29	10,362	12.98	1.84	7.46	11.93	13.89	29.10	1950	2015
% 15-29 / 30-59	10,362	90.03	24.66	31.93	67.64	108.80	154.74	1950	2015
% 15-24 / 25-59	10,362	49.77	13.64	13.78	37.56	60.26	80.89	1950	2015
Percent Male	10,520	49.80	2.49	42.65	48.90	50.28	76.07	1950	2015
Gini Index	4,728	38.02	8.70	18.10	31.50	43.90	63.30	1960	2015
GDP per Cap (USD 1k)	7,148	9.58	14.54	0.12	0.96	11.69	113.68	1960	2015
Percent Urban	8,938	48.05	24.62	2.08	27.69	67.76	100.00	1960	2015
State Fragility Index	3,406	9.30	6.67	0.00	3.00	15.00	25.00	1995	2016

Analytical Strategy

Descriptive Statistics

Very often, studies rely heavily on elaborate modeling strategies, at times ignoring the assumptions that support these models (Bushway et al., 2007). A single coefficient is just an average, and can hide interesting and important variation that occurs across observations. For that reason, this study relies extensively on the use of descriptive statistics and data visualization to explore co-occurring trends in homicide rates, age composition, and in other control variables.

Using data for the population of countries worldwide, rather than a sample, favors a descriptive approach, as the observed differences between observations can be taken at face value, without the need for inferential statistics. Also, using data for up to seven decades allows for the visualization of variations of variables over a long time. Finally, countries are very specific units of analysis, in the sense that most have historical events and period effects that can be specific to their own context. The individualized treatment of each country, prior to the calculation of aggregate statistics, allows the current study to understand the impact of each of these events, and to account for that impact.

Regional Trends

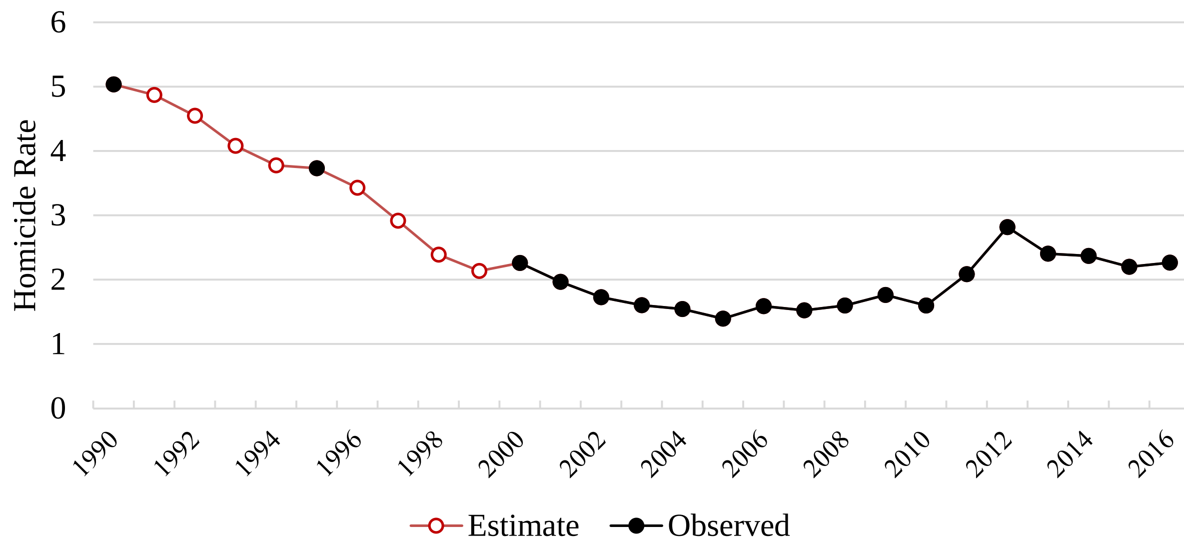
One of the main descriptive analyses used in the current study is the elaboration of trends of some indicators by Region, which are the aggregation of the trends of multiple individual countries. A major methodological challenge of producing such trends is caused by missing data. As some countries contain gaps in data for some years, the sample of countries with available data varies over time. Consequently, a regional trend that does not account for this issue will result in trends that are biased by the differences in the countries with missing data across years.

One solution for this issue is to equalize the sample of countries with homicide data available for each year. For that end, and exclusively for the purposes of calculating regional trends, missing years of each country were estimated using an Exponentially Weighted Moving average. For each individual country, the homicide rate of missing years was replaced by the average homicide rate of other years in that countries' series. In addition, the impact of each year on the average was exponentially weighted[23] by the time-difference between that year, and the year being

[23] Meaning that the weight of each year on the imputed average declined by half with each additional year-difference between that year and the imputed value.

estimated. Figure 4.4 is an example of this methodology applied to homicide data for Myanmar from 1990 and 2016.[24]

Figure 4.4: Moving Average Estimate of the Homicide Trend – Myanmar, 1990 to 2016



The moving average takes advantage of all available data in order to produce regional trends that are informative of the trends of indicators for each region. However, this methodology relies on the availability of data for a sizable proportion of a region's population over time. In the specific case of homicides, globally representative data are only available from the UN Homicide Statistics since 1990. In addition, as data coverage for Africa is relatively low, and as data are missing for

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[24] The resulting homicide trends are very similar to those obtained using a simple linear interpolation between the observed values nearest to the missing year. Both methods are also equality simple and parsimonious. However, because the moving average is influenced by all values in a countries' series, it is less sensitive to extreme homicides which may be specific to a single year (e.g. the US terrorist attacks of 2001), and more sensitive to remaining values of each country's series.

many of the most populous countries in the region, trends produced for Africa were mostly driven by the trend of South Africa – one of the few larger African countries with available data longitudinally. For that reason, trends for Africa were omitted from some analyses.

All other countries were grouped according to the regional groups of the United Nations geoscheme, which is based on the Standard Country or Area Codes for Statistical Use (also referred to as M49). This scheme is maintained by the United Nations Statistical Division, and is broadly used by other United Nations entities in their data analyses, reporting, and operations (United Nations Statistical Division, 2017).[25] The standard groups world countries according to their geographical continents, namely Africa, Americas, Asia, Europe, and Oceania.[26] Moreover, the M49 also classifies countries according to their subregion, which also reflect commonly used geographic designations. Appendix D contains the homicide trends of all 22 individual World's subregions, grouped by their corresponding regions according to the M49. Because homicide rates for Northern America were notably different from the remaining of the Americas (both in terms of level, and change), analyses were executed separately for Northern America and Latin America. Similarly, distinct trends were observed between Eastern Europe and the remaining of

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[25] Details about the scheme, and related tables can all be found at the website www.unstats.un.org/unsd/methodology/m49/
[26] Excluding Antarctica.

the European continent, as trends for the latter were largely affected by the dissolution of the Soviet Union, which ended in December of 1991 (Chervyakov et al., 2002). These differences justified the separation of analyses for Europe between Eastern Europe, and Western Europe.[27]

The resulting regional groupings used in this study are Asia, Eastern Europe, Latin America, Northern America, Oceania, Western Europe, and the World's total.

Average Effect of Age

The research questions of the current study have a longitudinal emphasis. They all pertain to drivers of homicide trends over-time, focusing on within-country variations in rates, rather than the explanations for the differences between countries. Accordingly, the current study used a fixed-effects liner regression, a specification that controls for the level of homicide of each country, thus providing the effect of each predictor in the change of homicides rates. In addition, a fixed-effects model takes advantage of the availability of repeated time-measures for each observation to control for the influence of all time invariant factors that could confound the relationship between each independent variable with changes in the dependent variable, even if those factors are not explicitly controlled for in the model. The following model specification is used.

[27] Which includes all other sub-regions of Europe.

$$Ln(Homicide_{it}) = \beta_0 + \beta_1 Percent\ 15\ to\ 29_{it} + \beta_j X_{it} + \alpha_i + \varepsilon_{it}$$

Where the left-hand side of the equation contains the natural log of the homicide rate of each country *i* at time *t*. The betas correspond to the coefficient sizes, and ε_{it} is the error term of each individual data point. The notation X_{it} corresponds to a vector of all time-varying control variables included in the model, and α_i refers to the country fixed effects, which account for country-level characteristics that are constant across time *t*. Additionally, standard errors were clustered to account for the dependence of year-observations within each country. Clustered standard errors were calculated using the White method for panel models (Allison, 2009; White, 1980; Wooldridge, 2002)

The fixed effects model, in addition to the inclusion of time-varying controls traditionally used in cross-national homicide research greatly minimize the risk of confoundedness from omitted variables. Other macro-level criminological research has used fixed effects successfully (Ousey & Kubrin, 2009; Phillips, 2006).

Variations in Effect

The current study also hypothesizes that null findings of previous research about the effect of percent young on homicide rates are partially a consequence of the emphasis on average association. More specifically, this study suggests that a direct relationship between percent young and changes in homicide rates may be more clearly identifiable in the most stable countries which faces the lowest levels of other criminogenic pressures. In contrast, the coefficient size of age composition should be the lowest in the countries with the highest homicide rates, where the impact of age on homicide trends is secondary to the influence of all other criminogenic forces.

Two parallel strategies were used to explore variations in the effect of percent young on homicide rates. The first is the inclusion of interaction terms between the percent young and other regressors in the fixed effects regression model. This inclusion enables the evaluation of variations in the size of the coefficient for age across the distribution of another independent variable (Aiken et al., 1991). More specifically, if the impact of age declines when other criminogenic forces are more prevalent, particularly the State Fragility Index.

$$\begin{aligned} Ln(Homicide_{it}) \\ &= \beta_0 + \beta_1 Percent\ 15\ to\ 29_{it} + \beta_2 State\ Fragility\ Index_{it} \\ &+ \beta_3 (Percent\ 15\ to\ 29 * State\ Fragility\ index)_{it} + \beta_{\mathrm{j}} X_{it} + \alpha_i \\ &+ \varepsilon_{it} \end{aligned}$$

A major shortcoming for evaluating variations in the effect of age composition is the lack of available data on criminogenic forces more generally. Many of the factors commonly linked to changes in homicides among the most violent countries, such as operations by organized crime organizations, do not have available measures. Other forces which are measured, such as high levels of inequality, may be better explanations for differences in homicides between places, than for changes in homicides over time. Finally, even if appropriate measures are available, such as the State Fragility Index, they may be only available for a shorter series.

In the current study, I propose the use of quantile regression (with fixed effects) to explore differences in the effect of age composition from countries with the lowest levels of homicides, to those with the highest levels. This analytical strategy purports to evaluate variations in the effect of age composition across countries experiencing differences in the prevalence of other criminogenic forces.

In a traditional Ordinary Least Square regression, each estimated coefficient correspond to the change in the conditional mean of a dependent variable given a one-unit change on an independent variable, while holding all other controls constant. Instead, by using a quantile regression researchers are able to estimate coefficients of independent variables at any given part of the distribution of the dependent variable, and not just at its average (Koenker & Bassett, 1978). Moreover, researchers can use a quantile regression to compare the strength of predictors across the distribution of a dependent variable. Most often researchers evaluate effects at the quantiles and the median of a dependent variable, but coefficients can be calculated for any given part of a distribution. This part is commonly designated by its corresponding percentile (tau; τ), which varies from 0 to 1 (Beyerlein, 2014; Britt, 2009; Hao & Naiman, 2007).

The main advantage of using a quantile regression is that it overcomes limitations in the availability of data on other criminogenic pressures by directly using homicide rates themselves, the presumed outcome of those forces, as an instrument for evaluating variations on the impact of age composition. Moreover, the quantile regression enables that evaluation across all years and countries with available data in the dependent variable, thus overcoming the limited availability of data for individual criminogenic forces.

I propose that the use of a quantile regression with fixed-effects is an efficient and parsimonious approach for evaluating the differences in effects hypothesized in the current study. By enabling the evaluation of differences in the effect of age composition across the distribution of homicide rates, a quantile regression enables the test of the propositions of the current study. Specifically, that the impact of the percent young on homicide rates becomes progressively more visible - and age is increasingly more relevant driver of change in homicide rates relative to alternative causes - as that relationship is evaluated in the absence of competing criminogenic pressures driving homicides.

Methods Summary and Research Questions

This sub-section summarizes the analytical strategies, specifying how each of the research questions outlined in Chapter 3 were operationalized and addressed.

The first research question seeks to estimate the average effect of percent youth on homicide rates. That relationship was estimated using a fixed-effects model to regress the natural log of the homicide rate on the percent of the population between 15 to 29 years of age. Parallel models were executed using the High Coverage Sample, and the Long Series Sample.

The second research question asks about differences in the effect of percent youth across world's regions. Analyses related to this question are in two directions. The first is an exploratory description of the trends in homicide rates and in age composition from 1990 to 2015, which seeks to explore the bivariate relationship between these two variables over time, and across regions. The second analyses consist in a fixed-effects regression model which includes an interaction term between the percent youth and each region.

The third research question explores if the effect of percent youth is conditional on the level of stability of countries. This question was addressed by including an interaction term between the percent youth and the State Fragility Index, which corresponds to a measure of the social and political stability of countries. The hypothesis of the current study tests if the coefficient size of the interaction term is negative and different than zero, which indicates that the effect of percent youth on homicide trends reduces as state fragility increases. Moreover, support for the hypothesis would require that the main effect of percent youth on homicides be positive, indicating that percent youth have a positive effect on homicide trends in countries with the lowest levels of instability (where the State Fragility Index equals zero). Because data on the State Fragility Index is only available since 1995, this analysis was only performed using the High Coverage Sample.

The forth research question asks if an observable effect of age composition on homicide trends is conditional on the level of homicide of countries. To answer this question, this study uses a quantile regression (with fixed-effects) to estimate the effect of percent youth on homicide trends at several percentiles of the homicide rate distribution.

Table 4.2 summarizes each research question, hypothesis, and the corresponding research methods related to each question. This table will be revisited at the end of Chapter 5 with a summary of related results.

Table 4.2: Summary of Research Questions, Hypotheses and Methods

Research Question	Hypothesis	Methods
1. Is there an average effect of percent youth on homicide trends?	The average effect of percent youth on homicide rate is positive and above zero.	Fixed-effects model regressing the natural log of homicide rate on the percent of the population between 15 to 29 years of age.
2.. Are there variations in the impact of percent youth across regions?	The average effect of percent youth on homicide rate varies by region. Moreover, that effect is positive and above zero for the regions which experienced homicide declines.	Fixed-effects model including an interaction term between a flag for each of the world's regions, and the percent of the population between 15 to 29 years of age.
3.. Is the effect of percent youth on homicide trends conditional on the level of stability of countries?	The effect of age composition on homicide trends is conditional on the level of state fragility of countries. In particular, the effect of age is stronger for countries with lower levels of instability, and weakens gradually as country instability increases.	Fixed-effects model including an interaction term between the State Fragility Index and the percent of the population between 15 to 29 years of age.
4.. Is the effect of percent youth on homicide trends conditional on the level of homicide of countries?	The effect of age composition on homicide trends is conditional on the level of homicide of countries. In particular, the effect of age is stronger for countries with lower levels of homicide, and weakens gradually as homicide rates increase.	Quantile regression (with country fixed-effects) estimating the effect of percent of the population between 15 to 29 years of age on the natural log of homicide rates at several percentiles of the homicide rate distribution.

Several additional analyses were performed in order to place findings obtained to the context the International Homicide Decline, and to test the sensitivity of findings to some of the specific methodological decisions of this study. Thus, analyses were guided, but were not limited to the research questions outlined above.

Chapter 5: Results

This chapter presents results from the analysis described in Chapter 4 and seeks to provide substantiated responses to the research questions presented in Chapter 3. Generally, the following analyses are an investigation of the association between the percent youth and homicide rates, and of the nuances in this relationship. This chapter begins with descriptive statistics of measures used in the study, followed by a measure of the average association between age composition and homicide rates. I then investigate the empirical plausibility of age composition as an explanatory factor for international homicide decline by contextualizing the estimated effect in terms of size and generalizability. That later assessment is further supported by the presentation of regional trends in homicide rates and in age composition for the world, and for each of the world's regions. Next, I investigate variations in the effect of age composition by the world's regions, across levels of state fragility, and among the distribution of homicide rates. I then present analyses assessing the sensitivity of results to some of the methodological choices and limitations of the current study. Finally, I provide a summary of findings directly relating the results of this chapter to the research questions outlined in Chapter 3.

Descriptive Statistics

The High Coverage Sample (from 1990 to 2015) and the Long Series Sample (from 1960 to 2015) are very distinct in their component countries. While all 26 countries in the Long Series Sample are also contained in the High Coverage Sample, most countries in the High Coverage Sample tend to, on average, perform worse on social and economic indicators. As presented on Table 5.1, on average, the homicide rate of the high coverage sample is 53% greater than the homicide rate of the Long Series Sample. The GDP per capita of the Long Series is almost two and a half times that of the High Coverage Sample, which also has a higher inequality of income, with a Gini index 4.6 points greater than the Long Series Sample. The demographic indicators are somewhat comparable, with the exception that the Long Series Sample is generally more urbanized (69.4% against 54%).

Table 5.1: Descriptive Statistics by Sample

Statistic	N	Mean	SD	Min	Pctl(25)	Pctl(75)	Max	Earliest	Latest
High Coverage Sample (Since 1990)									
Homicide Rate	2,567	8.00	13.06	0.13	1.36	8.53	142.16	1990	2015
Percent 15 to 29	4,082	25.72	3.66	14.68	23.18	28.21	36.03	1990	2015
% 15-24	4,082	17.78	3.11	9.34	15.33	20.01	26.21	1990	2015
% Male 15-29	4,082	13.08	2.08	7.46	11.63	14.23	26.04	1990	2015
% 15-29 / 30-59	4,082	86.17	29.29	31.93	57.81	111.70	154.74	1990	2015
% 15-24 / 25-59	4,082	47.11	16.00	13.78	31.80	61.41	80.89	1990	2015
Percent Male	4,160	49.93	2.84	45.79	48.97	50.16	76.07	1990	2015
Gini Index	3,303	38.44	8.41	18.10	32.50	43.80	63.30	1990	2015
GDP per Cap (USD 1k)	3,915	11.12	16.18	0.12	1.03	13.19	91.41	1990	2015
Percent Urban	4,101	54.01	23.49	5.42	35.17	73.43	100.00	1990	2015
State Fragility Index	3,249	9.36	6.69	0.00	3.00	15.00	25.00	1995	2016
Long Series Sample (Since 1960)									
Homicide Rate	1,621	5.23	10.00	0.07	0.89	3.65	81.41	1960	2015
Percent 15 to 29	1,716	23.49	3.38	14.68	20.99	25.90	33.46	1960	2015
% 15-24	1,716	16.01	2.82	9.34	13.91	18.25	23.62	1960	2015
% Male 15-29	1,716	11.89	1.69	7.46	10.67	13.08	17.98	1960	2015
% 15-29 / 30-59	1,716	68.59	21.44	31.93	53.11	80.02	129.58	1960	2015
% 15-24 / 25-59	1,716	38.33	11.96	18.14	29.59	45.18	70.92	1960	2015
Percent Male	1,716	49.38	0.87	46.22	48.82	49.87	52.19	1960	2015
Gini Index	1,190	33.82	8.55	20.20	26.90	40.60	53.00	1960	2015
GDP per Cap (USD 1k)	1,337	25.47	18.15	0.57	10.48	35.95	91.41	1960	2015
Percent Urban	1,456	69.41	15.61	19.67	61.26	80.95	100.00	1960	2015

Table 5.2 is a correlation matrix of the variables in each analytical sample. Several of the indicators have moderate to strong correlations with each other, which confirms findings of extant research (Pridemore, 2011), and supports the premise that social and economic disadvantages at the macro-level have a tendency to co-exist. Additionally, the table contains the variance inflation factors (VIFs) of each variable in a model using all other variables to predict the homicide rate, with fixed-effects. The VIFs in both samples remain below 3.5 suggesting no substantial problem with multicollinearity (Fox, 1991).

Table 5.2: Correlation Matrix per Sample with Variance Inflation Factor (VIF)

High Coverage Sample (Since 1990)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	VIF
(1) Homicide Rate	1.00							
(2) Percent 15 to 29	0.34	1.00						3.10
(3) Percent Male	-0.08	0.32	1.00					1.46
(4) Gini Index	0.53	0.64	0.13	1.00				1.73
(5) GDP per Cap (USD 1k)	-0.28	-0.65	0.14	-0.50	1.00			2.73
(6) Percent Urban	-0.06	-0.50	0.01	-0.31	0.61	1.00		1.65
(7) State Fragility Index	0.19	0.59	0.01	0.45	-0.64	-0.67	1.00	2.88
Long Series Sample (Since 1960)	(1)	(2)	(3)	(4)	(5)	(6)		VIF
(1) Homicide Rate	1.00							
(2) Percent 15 to 29	0.46	1.00						2.27
(3) Percent Male	0.10	0.43	1.00					1.26
(4) Gini Index	0.65	0.53	0.19	1.00				1.70
(5) GDP per Cap (USD 1k)	-0.41	-0.67	-0.17	-0.62	1.00			2.50
(6) Percent Urban	-0.06	-0.32	-0.11	-0.22	0.43	1.00		1.25

Note: The Variance Inflation Factors (VIFs) are based on a fixed effects model for the (Ln) Homicide Rate, controlling for all other variables in the matrix, for each sample.

The Average Relationship between Age Composition and Homicide Trends

Table 5.3 provides the results of the fixed effects linear regression using both the High Coverage and the Long Series Samples. The first model displays the bivariate association between the percent youth and changes in the homicide rate in the High Coverage Sample, which starts in 1990. The coefficient in this model indicates that a one percentage-point increase in the young population corresponds to an average increase of 3.8% in the homicide rate. However, after the inclusion of the control variables for demographic and economic indicators, the relationship is substantially attenuated to a value much closer to zero.

The two subsequent models estimate the relationship between percent youth and homicide rate using the 26 countries of the Long Series Sample. In the bivariate model, the results demonstrate that a one percentage point increase in the percent young increases the homicide rate by 5.1%. Moreover, with the inclusion of controls for demographic and economic factors, the effect increases to 5.4% for each one percentage point increase in the percent youth.

There are two possible explanations for the differences in effect between the Long Series Sample and the High Coverage Sample. First, differences could be due to the differences in the number of years, and in the timeframe encompassed by each sample. For instance, as suggested by Phillips (2006), it could be that the effect of age composition is time-dependent, and therefore contingent on other societal characteristics of a given period. A second explanation for the differences in effect would be the composition of countries in each sample. As demonstrated in Table 5.1, the Long Series sample has, on average, a much higher level of wealth, and much lower levels of homicide.

In order to determine whether the difference in the results between the Long Series and the High Coverage samples are driven by differences in the countries of each sample or by differences in the time frame between the two samples, the final two columns of Table 5.3 restrict the fixed effect regression of the Long Series Sample to only data since 1990. As effect sizes of this model are similar to those obtained using the original Long Series Sample since 1960, this analysis suggests that the differences in results between the Long Series and High Coverage sample are a consequence of the differences in the composition of countries included in each sample, rather than the changes to the time frame. Generally, the Long Series Sample is comprised of countries which are more economically developed and have lower levels of homicide than the High Coverage Sample (see Table 5.1). This result suggests there may be a difference in the effect of percent young across countries with different levels of homicides and with different concentrations of disadvantages more generally.

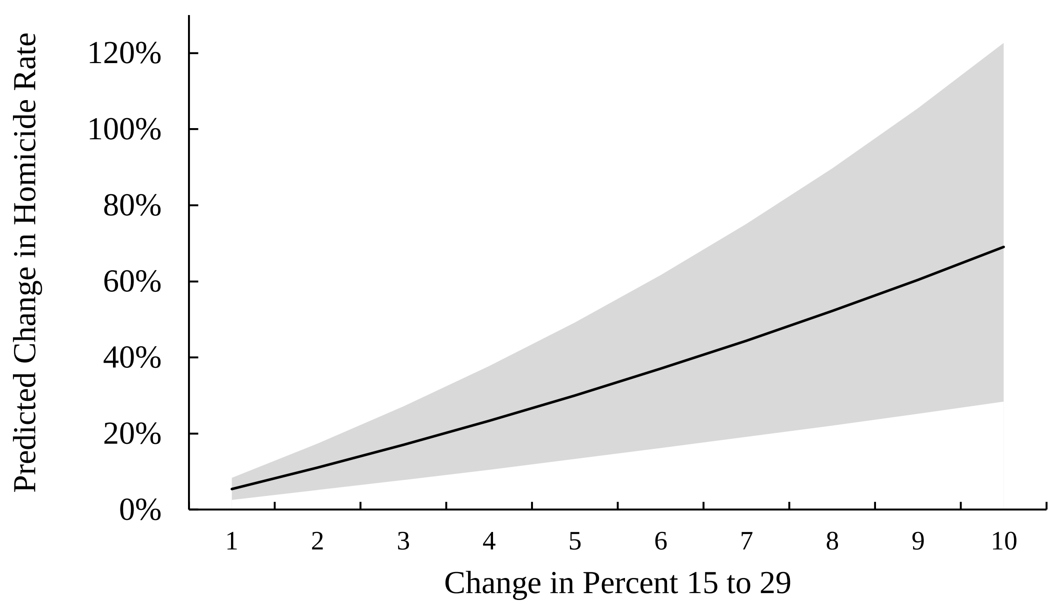
Table 5.3: Fixed Effects Models for the Average Effect of Percent 15 to 29 on Homicide Rates

	High Coverage Sample		Long Series Sample			
	Since 1990	Since 1990	Since 1960	Since 1960	Since 1990	Since 1990
Percent 15 to 29	**1.038****	**1.018**	**1.051*****	**1.054*****	**1.073*****	**1.058****
	(0.013)	**(0.015)**	**(0.014)**	**(0.014)**	**(0.015)**	**(0.021)**
Percent Male		1.032		1.125		1.135
		(0.053)		(0.075)		(0.078)
Gini Index		0.989		0.967		0.961
		(0.016)		(0.019)		(0.035)
GDP per Cap (1k)		0.969**		0.997		0.987
		(0.010)		(0.006)		(0.010)
Percent Urban		1.008		1.022*		1.015
		(0.009)		(0.009)		(0.016)
Observations	2,558	2,283	1,621	1,136	670	662
Countries	135	126	26	26	26	26
R^2	0.032	0.125	0.080	0.259	0.207	0.282
F Statistic	80.688***	61.538***	139.432***	77.294***	167.543***	49.458***

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

Figure 5.1 displays the predicted change in homicide rate for each unit change in the percent 15 to 29. Predicted values were calculated using the coefficient obtained in the fully-controlled model using the Long Series Sample. For reference, since 1980 the world experienced a decline of 2.5 percentage points in its population between 15 to 29 years. All regions, besides Africa, contributed to this decline. Northern America and Europe each experienced declines in their percent youth of more than 6 percentage points since 1980. Assuming that each percentage point change in the percent youth corresponds to a 5.4% increase in the homicide rate, a country which experienced a decline of 6.4 percentage points in the proportion of its population between 15 and 29 years (as did the United States between 1980 and 2010), would experience a predicted reduction of 40% in its homicide rate. The actual decline in the United States' homicide rate over that period was 48.4%.

Figure 5.1: Predicted Change in Homicide Rate from Unit-Increases in the Percent 15 to 29



Note: Confidence intervals correspond to an alpha level of 0.95.

This result suggests that an average effect of age composition on homicide trends at around 5% would be strong and sizable enough to explain large changes in homicide (e.g. the international homicide decline), and to contribute much to changes in homicide trends since 1960.

Cross-Sectional Evaluation of the Effect of Percent Youth on Homicide Rates

As discussed in Chapter 3, several of the studies which have investigated the relationship between demographic composition and homicide rates which were included in the systematic review conducted by Rogers and Pridemore (2016)[28] utilized a cross-section, as opposed to longitudinal data on homicide rates. Table 5.5 contains Ordinary Least Squares regression models using a cross-section of the High Coverage Sample for individual years in five-year increments between 1990 and 2015. The first column includes only a cross-section of data for 1990, the second model uses only data from 1995, and so forth. The dependent variable is the natural log of the homicide rate. To facilitate the interpretation, coefficients were transformed using their exponential, and correspond to the proportional increase in the homicide rate resulting from a one-unit increase in the independent variable.

[28] A complete list and summary statistics of all studies can be obtained at the manuscript's website at https://sites.google.com/site/homicidedata/a-comprehensive-evaluation-of-the-association-between-percent-young-and-cross-national-homicide-rates%20

Table 5.4: Cross-Sectional Models (Ordinary Least Squares) for the Average Effect of Percent 15 to 29 on Homicide Rates Across Years

	Cross-Section of Years (OLS Models)					
	1990	1995	2000	2005	2010	2015
Percent 15 to 29	1.013	1.035	1.022	1.066	1.100**	1.233***
	(0.069)	(0.059)	(0.041)	(0.040)	(0.029)	(0.033)
Percent Male	0.729**	0.610***	0.808***	0.859**	0.873***	0.714*
	(0.116)	(0.110)	(0.036)	(0.047)	(0.026)	(0.143)
Gini Index	1.078***	1.091***	1.085***	1.074***	1.060***	1.035*
	(0.015)	(0.013)	(0.012)	(0.014)	(0.013)	(0.016)
GDP per Cap (1k)	0.983**	0.984*	0.985*	0.993	0.988*	0.992
	(0.006)	(0.008)	(0.006)	(0.006)	(0.005)	(0.006)
Percent Urban	1.004	0.998	1.005	1.009	1.013*	1.015**
	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
Constant	13.816**	22.130***	8.297***	4.014	2.713**	10.822
	(4.609)	(4.517)	(1.709)	(2.193)	(0.953)	(6.322)
Countries	65	75	88	103	112	65
R^2	0.498	0.721	0.667	0.475	0.517	0.685
F Statistic	11.687***	35.601***	32.838***	17.551***	22.700***	25.642***

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated (except for the constant), and correspond to the average proportional increase in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

It is crucial to note that while several of the estimates obtained for the effect of percent 15 to 29 on homicide rates have similar magnitudes to the ones obtained using the fixed-effects models, the coefficient sizes are not directly comparable. The main reason for this limitation is that the fixed-effects model controls for all time-stable characteristics of each country, even if these are not directly included in the models as controls (Allison, 2009). Nonetheless, the models serve to illustrate differences in the predictors of homicide rates across modeling strategies.

The first notable characteristic across models is the very high value of the coefficients of determination, all close or above 0.5. Similar values are typical to cross-sectional models predicting homicide rates at the country level (Neapolitan, 1997; Nivette, 2011; Trent & Pridemore, 2012). In fact, most coefficient sizes are in line with findings from extant literature. Percent male has a notable negative effect on homicide rates, a finding which has been interpreted as indicative that a gender imbalance within a population may be a consequence of the prevalence of conflict or some other sources of social disruption which are highly associated with homicides (Hesketh & Xing, 2006; Pridemore, 2008; Trent & Pridemore, 2012). Also consistent with extant literature, the Gini index is found to have a positive, strong and consistent association with homicide rates, regardless of the year in which it is being evaluated (LaFree, 1999, Nivette, 2011). In contrast, the effect of aggregated economic wealth, as measured by the GDP per capita, is much less notable and consistent (Pridemore, 2011). Therefore, the models below constitute a general representation of other models produced by extant research.

Generally, effect sizes from the cross-sectional regressions are different from results obtained in the fixed-effects models. While percent male has a very clear negative impact in the cross-sectional models, in the fixed-effects regression that effect is largely mitigated (β = 1.032; p > 0.05). The same is observed for the coefficient related to the Gini index, which does not seem to have a clear longitudinal effect on homicide trends (β = 0.989; p > 0.05) regardless of a very strong cross-sectional association. One interpretation for this finding is that, while income inequality may help explain the differences in homicides between countries, it may be unable to explain the changes in homicide rates over time. This lack of a longitudinal association may be a consequence of the relative constancy of within-country levels of inequality, as shown in Figure 3.2 (of Chapter 3). In contrast, GDP per capita does not have a consistent nor robust effect on homicide rates cross-sectionally, but the variable is a consistently strong predictor of homicide rates in the fixed-effects model ($\beta = 0.969$; $p < 0.001$), suggesting that economic wealth may perform much better in explaining changes in homicide rates over time[29], than in explaining the differences in the level of homicides between countries.

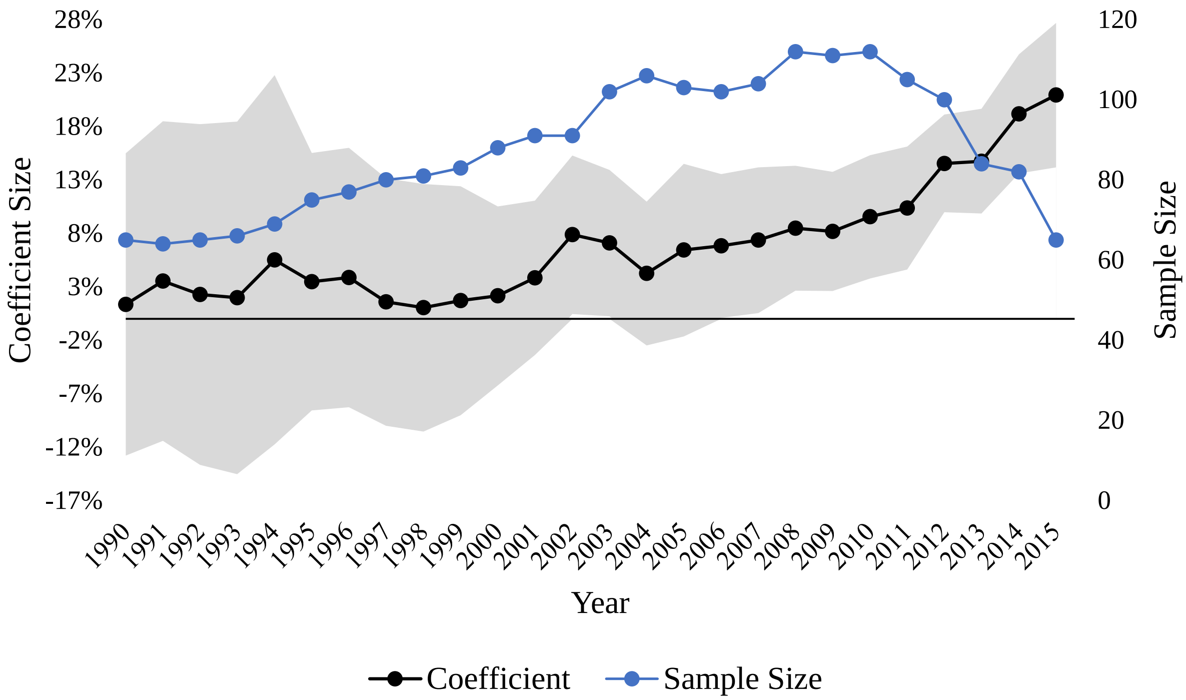
Much like what was identified by Rogers and Pridemore (2016) in their systematic review, a directly observed effect of age composition is not found across the regression models using data for most years, with the exception of the most recent years in the sample. While differences in the effect sizes across year-samples may be a consequence of variations in the country-composition of each year-sample, these results also suggest that cross-sectional analyses may be sensitive to the exact year of data under examination, which constitute an additional concern for macro-level researchers.

Figure 5.2 shows the effect size of the coefficient of the percent 15 to 29 in linear regressions predicting the homicide rate at each individual year with available data in the High Coverage Sample. The black line illustrates coefficient sizes, while the blue line represents the number of countries included in the sample for each year. As the figure suggests, the coefficient of percent youth is not significantly different

[29] One potentially interesting theoretical explanation for this effect is relative deprivation, as individuals may feel a reduction in strain from an improvement in their own economic condition, relative to themselves in the past. I intend to explore this topic in future research.

from zero between 1990 and 2006, when the coefficient turns significantly positive until 2015. Generally, the figure corroborates the conclusion by Rogers and Pridemore (2016) that a directly observable relationship between age composition and homicide rates does not exist, particularly when that relationship is evaluated cross-sectionally. Most importantly, however, these findings suggest that the particular finding of an effect for age is highly dependent on the specific year in which that association is being evaluated.

Figure 5.2: Coefficient of the Percent 15 to 29 in OLS Cross-Sectional Regression Models by Year



Note: Confidence intervals correspond to an alpha level of 0.95. Coefficients were extracted from models which include all control variables included in the main fixed-effects model, with robust standard errors.

Differences in the Effect of Age Across Series Specifications

One of the key differences between the current study and past research is the use of a broader sample of countries, which also covers a much larger number of years than most comparative cross-national research which has investigated the effect of age composition on homicide trends. Other studies on the homicide decline in the United States, and on the effect of percent youth on homicide trends more generally, most often use data which includes a much smaller number of years than the current study. For example, a study of the United States homicide decline by Phillips (2006) contained a short-term evaluation of the effect of age composition on crime trends using data between 1995 and 1999 - in which the author found a null effect of percent youth on homicide trends. In the systematic review conducted by Rogers and Pridemore (2016) of the cross-national literature on the effect of age composition on homicide trends, the authors also conducted their own analyses using data from 1999 to 2005. In the latter study, the authors used the null findings of their own analysis to add support for their conclusion that age composition is not a predictor of homicide rates. The current section directly explores the sensitivity of results to the use of the year ranges employed by that literature.

Table 5.6 compares coefficient sizes for the main fixed-effects model across multiple specifications of the series of data used. The difference between models is in the range of years included in the analysis. All comparisons were executed using the High Coverage Sample. In particular, the table compares effect sizes across samples using the years between 1990 and 2015, between 1995 and 1999, and between 1999 and 2005.

Results are relatively similar regardless the range of years selected. For the range between 1995 and 1999, coefficient sizes are both small and not significant both in the bivariate model specification and in the fully controlled model. For the range between 1999 and 2005, results show that when restricted to that particular range of years, the effect of age composition on homicide rates is negative, but not distinguishable from zero.

Table 5.5: Fixed Effects Models for the Average Effect of Percent 15 to 29 on Homicide Rates Across Series' Specifications

	High Coverage Sample					
	1990 to 2015		1995 to 1999		1999 to 2005	
Percent 15 to 29	1.038** (0.013)	1.018 (0.015)	1.017 (0.022)	0.993 (0.023)	0.986 (0.024)	0.974 (0.027)
Percent Male		1.032 (0.053)		1.325* (0.121)		1.147* (0.066)
Gini Index		0.989 (0.016)		0.016 (0.023)		0.997 (0.025)
GDP per Cap (1k)		0.969** (0.010)		0.962*** (0.010)		0.971* (0.012)
Percent Urban		1.008 (0.009)		1.026 (0.022)		1.002 (0.014)
Observations	2,558	2,283	416	396	714	664
Countries	135	126	94	87	122	113
R^2	0.032	0.125	0.002	0.069	0.002	0.034
F Statistic	80.688***	61.538***	0.765	4.394***	0.920	3.834**

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

It is important to note that there are differences in the sample of countries with data at each range. The fully-controlled model between 1995 and 1999 contains data from 87 countries, while the model between 1999 and 2005 contains data for 113 countries. Those counts are substantially smaller than the 126 countries included in the sample from 1990 to 2015. Table 5.7 presents an additional analysis to consider whether effects would be different if all samples included the same number of years (between 1990 to 2015), and if their only difference related to the countries included in each sample. Each model of the table includes all years of data available in the High Coverage Sample (from 1990 to 2015), but for each model the data was restricted to the countries which only had available data in the specific year range presented in Table 5.6. Thus, the table only reduces the number of countries included in each sample, while keeping the number of years constant across models. The purpose of these models is to explore if the differences in effect between the series' specifications is due to the period of time used, or to the country-composition of the samples.

As demonstrated in the table, results from all bivariate associations become significant – a direct consequence of the increase in sample size – although the coefficient size for the countries with data between 1999 and 2005 is now negative. Most importantly, the coefficient of percent youth in the fully-controlled models, regardless of the sample of countries, is small and not significant. Generally, results across all fully-controlled models are very similar in Table 5.10, with coefficient sizes that are very small and not significant.

Table 5.6: Fixed Effects Models for the Average Effect of Percent 15 to 29 on Homicide Rates Across Series' Specifications

	1990 to 2015 Countries		High Coverage Sample 1995 to 1999 Countries		1999 to 2005 Countries	
Percent 15 to 29	1.038** (0.013)	1.018 (0.015)	1.041*** (0.014)	1.016 (0.017)	0.986** (0.024)	0.974 (0.027)
Percent Male		1.032 (0.053)		1.142 (0.068)		1.147 (0.066)
Gini Index		0.989 (0.016)		0.981 (0.017)		0.997 (0.025)
GDP per Cap (1k)		0.969** (0.010)		0.970** (0.010)		0.971** (0.012)
Percent Urban		1.008 (0.009)		1.010 (0.010)		1.002 (0.014)
Observations	2,558	2,283	2,146	1,937	2,350	2,218
Countries	135	126	94	87	122	113
R^2	0.032	0.125	0.039	0.151	0.033	0.126
F Statistic	80.688***	61.538***	83.088***	65.642***	76.860***	60.528***

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

Results presented until now suggest that differences in the findings between the current study and past research are not as influenced by the use of a longer series of years. Like previous research, the main model utilizing the High Coverage Sample (since 1990) also did not yield a directly observed average effect of percent youth on homicide trends (presented in Table 5.3). Instead, an effect was only identified when using the Long Series Sample (since 1960), not because it included a larger number of years, but because that sample is restricted to countries which are generally more politically stable, wealthier, and safer than the world average.

Hence, the main limitation of previous research that explains differences with the current research appears to be the *excessive reliance on average effects*, which may have hidden the nuances of the relationship between age composition and homicide trends. In the present study, I am able to take advantage of a broad database on homicides containing a diverse sample of countries to adequately explore heterogeneity in the effect of age composition across the world's regions, across degrees of state fragility, and across level of homicide.

Regional Trends

This section presents a descriptive analysis of trends in homicide and in age composition across the world's regions. The purpose of this analysis is not to provide conclusive statements, but instead to enrich this study by illustrating the bivariate association between age composition and homicide trends, including an observation of the times and locations where such relationship is non-existent. Hence this visualization exercise seeks to provide meaning to the heterogeneity in effects identified thus far, while supporting subsequent analyses.

Figure 5.3 presents trends in homicide and in the percent youth aggregated for the entire world, and for each of the world's regions, between 1990 and 2015. Over that period, the global homicide rate went through a gradual, yet sharp decline of 19.7%, when it declined from 6.1 to 4.9 homicides per 100,000 individuals. This global decline is reflective of declines throughout almost all of the world's regions, with declines of over 40% occurring in homicide rates of Western Europe and Northern America, 37.5% in Asia, and with both Oceania and Eastern Europe experiencing declines in homicide rates of nearly 20%.

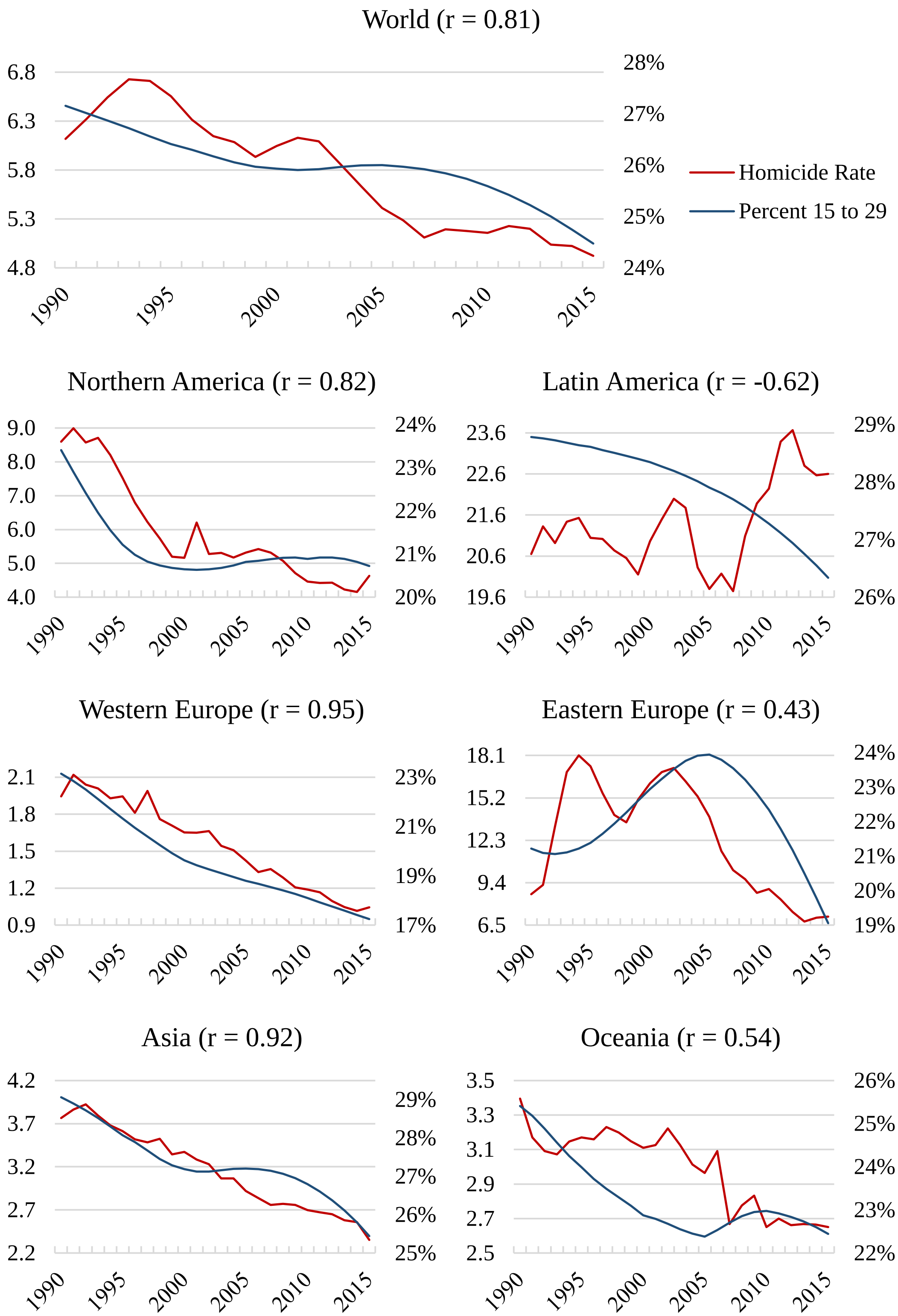
These regions, and the world as an aggregate, also experienced strong declines in the relative size of their youth population since 1990. In the world, the proportional participation of youth declined from 27.2% to 24.2% of the entire population. Certain regions had even greater declines in that proportion. For instance, in Asia, the percent youth declined from 28.6% to 24.9% of the total population, and Northern America experienced a decline from 23.4% to 20.7%. All regions of the world besides Africa experienced similar declines, with the extreme being Western Europe, where the relative size of the youth population dropped by more than 25%, from 23.1% to 17.2% of the total population.

In regions where the youth population and homicides declined concurrently, a very strong bivariate relationship exists between the two series, as expressed by the Pearson correlation included in each graph. For the entire world, that correlation is at 0.81, which is a very high value. In specific regions such as Northern America (0.82), Asia (0.92), and Western Europe (0.95) that correlation is even stronger, and very close to the maximum value of the Pearson correlation index of one. Moreover, in addition to a generally strong association between homicide trends and demographic composition for the entire world and across individual regions, there exists a pattern of particularly strong correlations in the regions which, already in 1990, had the lowest levels of homicides, and which experienced the strongest declines in homicide.

There are two exceptions to the above patterns which are most relevant for the current study. First, is the case of Eastern Europe during the 1990s, when the homicide rate of the region increased sharply from a rate of 8.6, to 17.4, followed by a decline to 13.5. This immense volatility can be largely attributed to the dissolution of the Soviet Union, which concluded in 1991 (Chervyakov et al., 2002). Somewhat similar to the crack epidemics, the end of the Soviet Union was a particularly criminogenic period effect, which might have generated discontinuity in the association between percent young and homicide rates over that specific time.

The second exception is Latin America, which already in 1990 had, by far, the world's highest homicide rate, at 20.6 per 100,000 individuals. While the region also experienced a decline in their youth population, which occurred at an increasing rate, the bivariate correlation between age composition and the homicide rate of the region is actually negative. More importantly, homicide rates appear largely irresponsive to demographic shifts, a pattern that contrasts with the relationships observed in other regions. The current study does not seek to provide an explanation for the heightened levels of violence in Latin America, but many countries in the region experience high levels of inequality, a strong influence of organized crime, have suffered sharpened events of economic downturn, in addition to several other sources of social and political instability since 1990 (Briceño-León et al., 2008). In effect, these factors likely constitute a range of criminogenic forces which not only drive homicide rates to a level well beyond that of other regions, but which may also support those rates at such levels, regardless of the impact of demographic shifts.

Figure 5.3: Homicide Rate and Percent of Population 15 to 29 by Region – 1990 to 2015



The Effect of Age Composition on Homicide Trends by Region

Consistent with aggregated trends by region presented in Figure 5.3, there is substantial variation in the effect of percent 15 to 29 across regions of the world. The first two models in Table 5.8 present a copy of the fully controlled models using the High Coverage Sample (since 1990), and the Long Series Sample (since 1960). The third and fourth models include an interaction term with the coefficient sizes of percent 15 to 29 for each of the world's regions. The region of Africa is the reference category.[30] The effect sizes of all interactions refer to the difference in effect of the percent 15 to 29 on homicide rates between each region and Africa.

[30] Regions were categorized alphabetically. Coincidentally, Africa also has the smallest coefficient of percent 15 to 29.

Table 5.7: Fixed Effects Models for the Interaction between Percent 15 to 29 and Region

			Interaction Models	
	Since 1990	Since 1960	Since 1990	Since 1960
Percent 15 to 29	1.018	1.054***	**0.984**	**0.941*****
	(0.015)	(0.014)	**(0.036)**	**(0.006)**
Regions Interactions (Africa = 0)	-	-		
Percent 15 to 29*Asia	-	-	**1.020**	**1.162*****
			(0.046)	**(0.023)**
Percent 15 to 29*Eastern Europe	-	-	**1.096***	**1.214*****
			(0.041)	**(0.021)**
Percent 15 to 29*Latin America	-	-	**0.987**	**1.030**
			(0.064)	**(0.040)**
Percent 15 to 29*Northern America	-	-	**1.059**	**1.127*****
			(0.062)	**(0.012)**
Percent 15 to 29*Oceania	-	-	**1.008**	**1.077*****
			(0.046)	**(0.019)**
Percent 15 to 29*Western Europe	-	-	**1.043**	**1.120*****
			(0.040)	**(0.014)**
Percent Male	1.032	1.125	1.050	1.074
	(0.053)	(0.075)	(0.061)	(0.088)
Gini Index	0.989	0.967	0.990	0.960*
	(0.016)	(0.019)	(0.016)	(0.017)
GDP per Cap (1k)	0.969**	0.997	0.970**	0.997
	(0.010)	(0.006)	(0.011)	(0.005)
Percent Urban	1.008	1.022*	1.007	1.022**
	(0.009)	(0.009)	(0.010)	(0.008)
Observations	2,283	1,136	2,283	1,136
R^2	0.125	0.259	0.141	0.332
F Statistic	61.538***	77.294***	31.930***	49.686***

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

Consistent with the average effect shown in Table 5.3, in the interaction model applied to the High Coverage Sample, almost all coefficients are not significantly different than zero. The single exception is Eastern Europe, where an increase of one percentage point in the population 15 to 29 corresponds to an increase of 7.9% in the homicide rate.[31] The effect sizes using the Long Series Sample (since 1960) are generally in the same direction as those observed in the High Coverage Sample, with the key difference being that those effects tend to be much more pronounced.

Figure 5.3 illustrates the effect sizes for each region in the interaction model using the Long Series Sample. As it demonstrates, the effect of percent 15 to 29 is significant and very pronounced across all regions of the world, with the exception of Latin America, Africa, and Oceania. In Asia, for instance, each increase of one percentage point in the youth population corresponds to an increase of 9.4% in the homicide rate, an association which is substantially stronger than the average effect of 5.4%. In Latin America, the effect size is small, and very close to zero. In Africa the coefficient actually turns negative, although effect sizes should be interpreted with reservation, as the single African country in the Long Series Sample is Mauritius.

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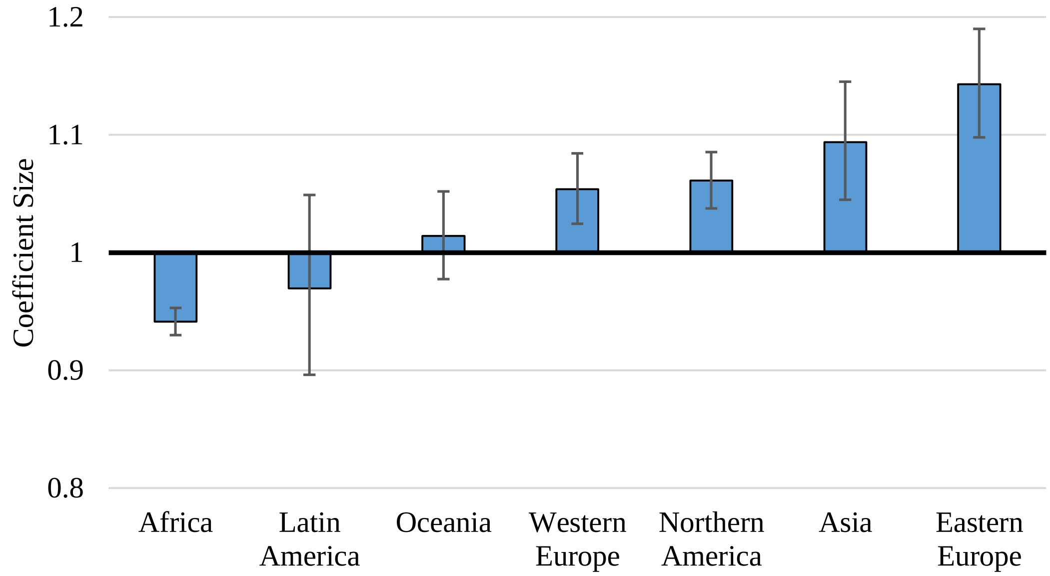
[31] The value of 7.9% was obtained by adding the untransformed coefficient for the reference category (-0.016) from the untransformed coefficient of the interaction with Eastern Europe (0.092). The exponential of the value equals 1.079, or a percent increase 7.9%. The 95% confidence interval of that estimate is between 3.6%, and 12.3%.

Figure 5.4: Coefficient Size of Percent 15 to 29 on Homicide Rate by Region – Sample Since 1960



Note: Confidence intervals correspond to an alpha level of 0.95. All effect sizes were obtained by expoentiating the addition of the untransformed coefficient of the reference category, with the untransformed coefficient of the interaction relative to each region.

The analysis by region support several insights about the relationship between age composition and homicide trends. First, it demonstrates the strength and generality of the intentional homicide decline, and of the global aging of populations. Second, they illustrate the strength and generality of the association between homicide trends and the percent youth. Finally, they suggest a source of heterogeneity in the effect of age composition and homicides. In particular, the effect of population age on homicides is conditional on the absence of other criminogenic forces pressuring homicide rates higher, such as the ones experienced by Latin America, and by Eastern Europe during the 1990s. It is possible that these forces are preventing Latin America or the most violent countries in the world from enjoying the pacifying influence of an aging of their populations.

Sources of Variation in the Impact of Age

The current study also seeks to explore variation in the effect of the percent youth on homicide trends across levels of state fragility, and across levels of homicide. Both measures are used as strategies to explore the influence of alternative criminogenic forces on the effect of age composition on homicide trends. In particular, the following analyses seek to explore if the directly observable effect of age composition on homicide trends is contingent on the absence of other criminogenic forces influencing homicide rates.

State Fragility

As a test of whether the impact of percent youth on homicide rates is mitigated by country instability, this study includes a moderation analysis using the State Fragility Index (SFI). The index is a summary measure of a state's ability to address crises, conflicts, and social problems by effectively intervening when necessary, and by maintaining systemic peace and stability towards development. Because the index is only available from 1995 to 2017, analyses using the SFI are restricted to the High Coverage Sample.

To test whether SFI mitigates the observable impact of age composition on homicides, I incorporated an interaction term between SFI and percent young in the fixed effects model of the High Coverage Sample. As presented in Table 5.9, both percent young and State Fragility are positively associated with homicide rates. However, the coefficient for the interaction between SFI and percent young is negative, indicating that Percent 15 to 29 has the strongest effect on changes in homicide rate in countries with the lowest level of state fragility, whereas the impact of age on homicide becomes progressively smaller as the State Fragility Index increases.

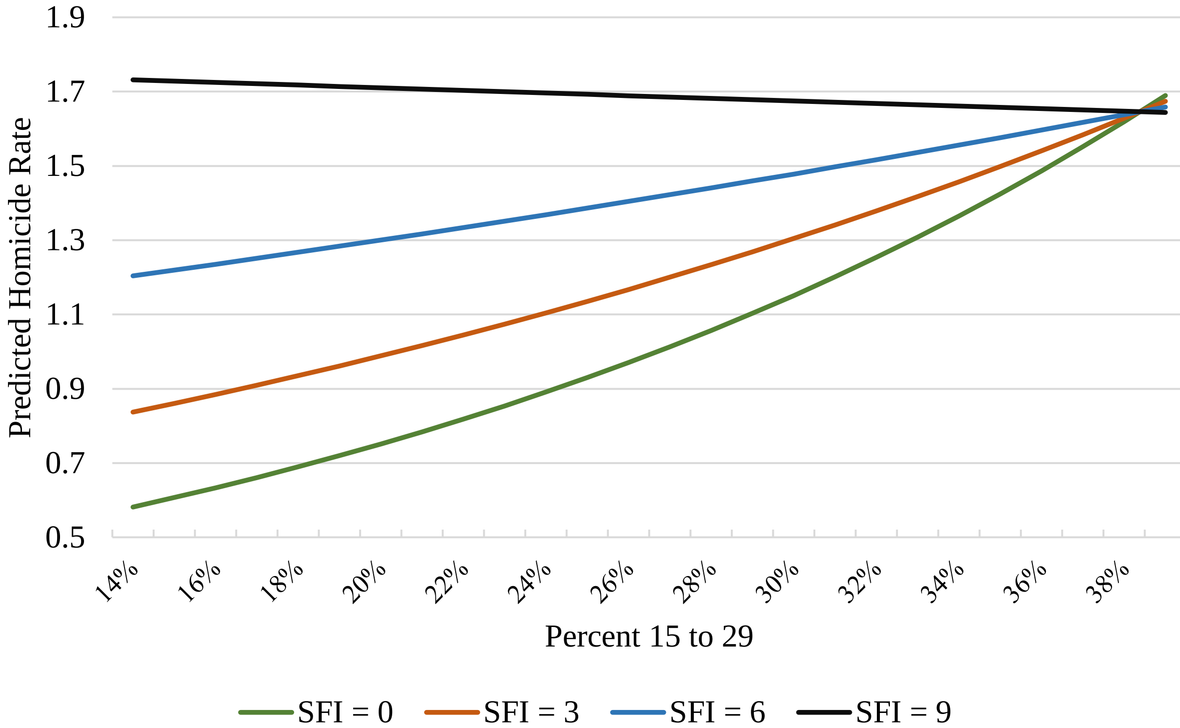
Table 5.8: Fixed Effects Models for the Interaction between Percent 15 to 29 and the State Fragility Index

	Since 1990	Since 1990	Since 1990	Since 1990
Percent 15 to 29	**1.038****	**1.031****	**1.019**	**1.044****
	(0.013)	**(0.011)**	**(0.014)**	**(0.014)**
Percent Male			0.975	0.978
			(0.022)	(0.023)
Gini Index			0.985	0.987
			(0.015)	(0.014)
GDP per Cap (1k)			0.964***	0.969***
			(0.008)	(0.008)
Percent Urban			1.009	1.007
			(0.009)	(0.009)
State Fragility Index (SFI)		**1.061*****	**1.065*****	**1.210*****
		(0.013)	**(0.013)**	**(0.050)**
Percent 15 to 29 * SFI				**0.995****
				(0.002)
Observations	2,558	2,109	1,895	1,895
R^2	0.032	0.105	0.227	0.245
F Statistic	80.688***	116.460***	86.633***	82.028***

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

Figure 5.5 illustrates this interactive effect by displaying the predicted homicide rate by the percent 15 to 29 for countries at four levels of state fragility. This figure illustrates that the percent 15 to 29 has a strong effect on homicide rates when the SFI equals zero, however, that effect becomes progressively smaller, and eventually disappears, when evaluated at higher levels of state fragility. These results provide support for the conclusion that age composition has a strong impact on homicides trends, although this effect is only observable in the absence of other sources of social disruption, when countries are most stable. As levels of instability increase, the effect of age composition becomes undistinguishable from zero, when the influence of demographic forces likely becomes of second-order importance in driving rates of homicides to the concentration of other disadvantages afflicting a given country.

Figure 5.5: Predicted Homicide Rate by Percent 15 to 29 and Level in the State Fragility Index



Level of Homicide

A quantile regression with fixed effects was used as an analytical strategy to evaluate the relationship between percent youth and homicide rates conditional on the level of homicide of countries. This analysis sought to explore if the effect of age composition on homicides is conditional on the prevalence of other criminogenic pressures by directly using the level of homicide, the presumed outcome of these criminogenic forces, as an analytical strategy for evaluating variations on the impact of demographic forces.

Tables 5.10 display the coefficients and standard errors from the models executed using the High Coverage Sample. The first column presents coefficients on the average homicide rate, which is a copy of the fixed-effects model originally presented in Table 5.3. In this model, the percent 15 to 29 has only a small effect on homicide trends. Values in all subsequent columns refer to the first and last deciles of the homicide rate distribution (τ = .1; and τ = .9), in addition to the first, second, and third quartiles (τ = .25; τ = .50; and τ = .75). The coefficient for the percent 15 to 29 is largest in the lower portions of the homicide rate distribution, and becomes progressively smaller at the higher ends of the homicide rate distribution. For countries at the first percentile of the homicide rate distribution, an addition of one unit in the percent 15 to 29 corresponds to an increase of 4.6% in the homicide rate. The effect at the mean of the homicide rate distribution is much smaller, and very similar to the effect at the average (a reflection of the normality of the distribution of the logged homicide rate). For countries which have the highest homicide rates, the coefficient size is very close to one, which corresponds to a null effect.

Table 5.9: Quantile Regression with Fixed Effects for the Effect of Percent 15 to 29 on (Ln) Homicide Rates – Since 1990 Sample

	Fixed Effects	*Quantile Fixed Effects Models*				
		$\tau = 0.1$	$\tau = 0.25$	$\tau = 0.5$	$\tau = 0.75$	$\tau = 0.9$
Percent 15 to 29	**1.018**	**1.046*****	**1.039*****	**1.015**	**1.011**	**1.006**
	(0.015)	**(0.008)**	**(0.007)**	**(0.010)**	**(0.008)**	**(0.008)**
Percent Male	1.032	1.017	1.053	1.087	1.059	1.037
	(0.053)	(0.052)	(0.050)	(0.054)	(0.056)	(0.045)
Gini Index	0.989	1.009	1.002	0.975**	0.971***	0.970***
	(0.016)	(0.010)	(0.008)	(0.008)	(0.007)	(0.006)
GDP per Cap (1k)	0.969**	0.970***	0.970***	0.965***	0.962***	0.964***
	(0.010)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Percent Urban	1.008	1.009*	1.006	1.008	1.008	1.007
	(0.009)	(0.004)	(0.003)	(0.005)	(0.005)	(0.005)
Observations	2,283	2,283	2,283	2,283	2,283	2,283

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

Table 5.11 presents the exact same model as Table 5.10 but applied to the Long Series Sample. Already in the original fixed effect model (which is a copy from Table 5.3) the association between percent youth and homicide rates was already large and substantial. That coefficient becomes even greater when evaluated at the first decile of the distribution of homicide rates, at 8.5% more homicides for each additional unit in the percent 15 to 29. Moreover, following a similar pattern to the High Coverage Sample, effect sizes become progressively smaller when evaluated at higher levels of the homicide rate distribution. Generally, the magnitude of the coefficient of percent young is larger in the Long Series Sample, which is comprised of countries with lower homicide rates than countries in the High Coverage Sample.

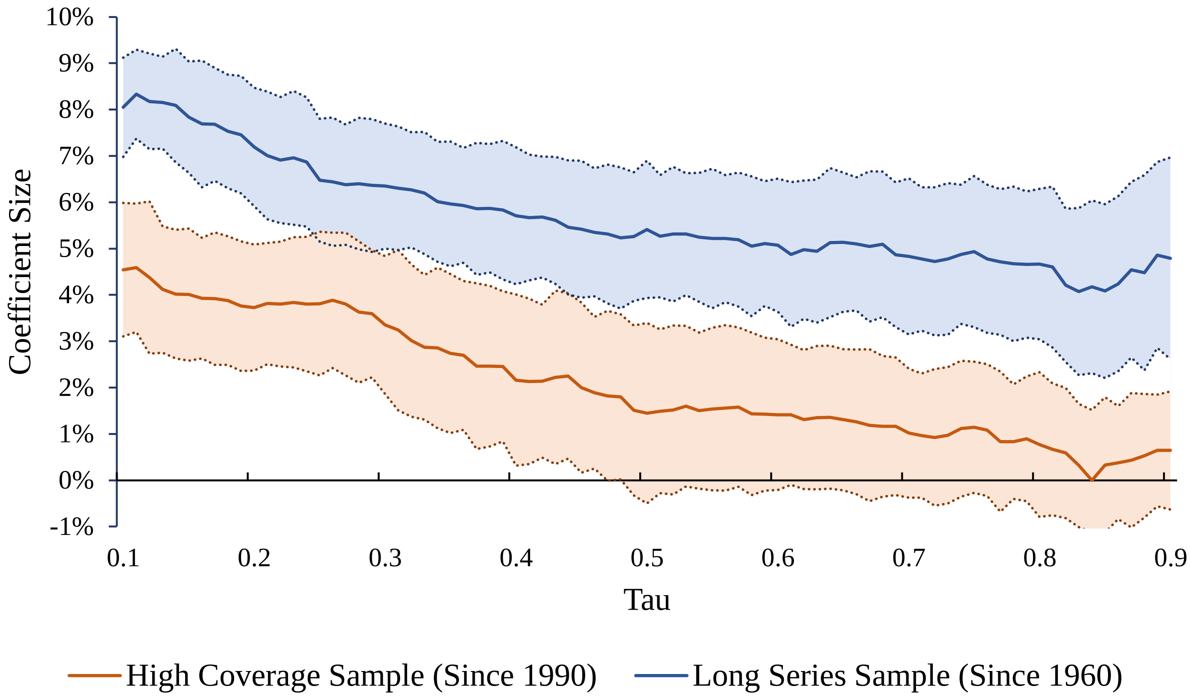
Table 5.10: Quantile Regression with Fixed Effects for the Effect of Percent 15 to 29 on (Ln) Homicide Rates – Since 1960 Sample

	Fixed Effects	*Quantile Fixed Effects Models*				
		$\tau = 0.1$	$\tau = 0.25$	$\tau = 0.5$	$\tau = 0.75$	$\tau = 0.9$
Percent 15 to 29	**1.054*****	**1.085*****	**1.071*****	**1.054*****	**1.050*****	**1.050*****
	(0.014)	**(0.005)**	**(0.007)**	**(0.008)**	**(0.008)**	**(0.010)**
Percent Male	1.125	1.025	1.079	1.095*	1.045	0.988
	(0.075)	(0.042)	(0.045)	(0.045)	(0.060)	(0.088)
Gini Index	0.967	0.954***	0.959***	0.960***	0.966**	0.988
	(0.019)	(0.005)	(0.006)	(0.007)	(0.011)	(0.013)
GDP per Cap (1k)	0.997	1.002	1.000	0.996	0.993*	0.995
	(0.006)	(0.002)	(0.002)	(0.002)	(0.003)	(0.005)
Percent Urban	1.022*	1.021***	1.023***	1.026***	1.028***	1.026***
	(0.009)	(0.003)	(0.003)	(0.003)	(0.002)	(0.004)
Observations	1,136	1,136	1,136	1,136	1,136	1,136

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

Figure 5.6 summarizes and adds detail to tables 5.10 and 5.10. The figures illustrate the sizes, and the 95% confidence interval of the estimated coefficients of the percent 15 to 29 at each individual percentile of the homicide rate distribution (Tau). One series, in orange, illustrates effects at the High Coverage Sample (since 1990), and another series, in blue, represent effects at the Long Series Sample (since 1960). The figure reflects the same findings as the tables. The effect of percent 15 to 29 on homicide rates is very high when evaluated in the lowest levels of homicides in both samples. For instance, country/years in the first percentile of the homicide rate distribution of the High Coverage Sample are expected to experience a 4.6% increase in their homicide rates for each addition of one unit in their percent youth. In the Long Series Sample, that same coefficient is at 8%. In both samples, the effect of percent youth becomes progressively smaller as that relationship is evaluated at higher levels of the homicide rate distribution. These results are evidence that age composition is a strong predictor of homicide rates, but that this effect became gradually less apparent when evaluated at higher levels of homicide. In the current study, that variation in effect is interpreted as evidence that composition may be key in explaining changes in homicides over time, but that the effect of demographic forces becomes indistinguishable from other criminogenic forces when extant risk factors for violence gain prominence.

Figure 5.6: Coefficient of the Percent 15 to 29 in Quantile Regression (with fixed effects) by (Ln) Homicide Rate Percentile and by Sample



Note: Confidence intervals correspond to an alpha level of 0.95.

Sensitivity Analyses

This section evaluates the sensitivity of this study's findings to some methodological decisions. First, the section includes an investigation of the use of a combination between the UNODC and WHO homicide statistics as the dependent variable for the Long Series Sample, but comparing results obtained using this combined dependent variable with analyses performed using only the WHO original data for the 26 countries in the Long Series Sample. A second analysis explores the sensitivity of findings to the operationalization of percent youth by replicating the models using percent of the population between 15 to 24 years of age, and the percent of the population who are males and between 15 to 29 years of age, as opposed to the original measure of the population between 15 to 29 years. A third analysis explores variations in effect between multiple measures of youth cohort size relative to older age groups, which was used as a preliminary investigation and discussion about the underlying theoretical mechanisms driving the effect of age composition. One final sensitivity analysis investigates the impact of missing data in the control variables on the results obtained in the main regression models used in this research.

Generally, results from all sensitivity analyses suggest that findings of this dissertation are not sensitive to any of the methodological choices outlined above. Following are details about each of these investigations. The subsequent section (Summary of Findings and Research Questions) summarizes all findings of Chapter 5, and directly relates those findings to the research questions of the current study.

Comparison between Combined Homicide Series and WHO Original Data

A potential criticism to current findings could relate to the perceived incompatibility between the UNODC and the WHO homicide statistics. In the current study, adjusted WHO data until 1989 were combined with UNODC data since 1990 to extend the series of 26 countries included in the Long Series Sample. The main assumption underlying this combination is that, for those 26 countries, homicide data from both sources are largely compatible.

That compatibility is visually demonstrated in Appendix A, which includes graphs of the homicide trends of the countries which had their data combined. Two additional analyses support the use of the combined series. First, the Pearson correlation between the overlapping years of the UNODC homicide rate and the WHO homicide rate, for countries which had their data combined is above 0.99. In addition, Table 5.12 presents the results of fixed effects regression using data for the

26 countries in the Long Series Sample. The first two models use the combined homicide series as the dependent variable. For contrast, the third and fourth models use only WHO data for the same sample of 26 countries. The models yield very similar results both in the bivariate, and in the fully controlled models. These results reflect the high compatibility between the UNODC and the WHO data.

Table 5.11: Sensitive Analysis Comparing Results of the Long Series Sample Using the Combined UN & WHO Series, Against the WHO Series Alone

	Combined Series		WHO Only	
	Since 1960	Since 1960	Since 1960	Since 1960
Percent 15 to 29	**1.051*****	**1.054*****	**1.059*****	**1.053***
	(0.013)	**(0.015)**	**(0.014)**	**(0.021)**
Percent Male		1.125*		1.117
		(0.053)		(0.078)
Gini Index		0.967*		0.965
		(0.016)		(0.035)
GDP per Cap (1k)		0.997		0.993
		(0.010)		(0.010)
Percent Urban		1.022*		1.021
		(0.009)		(0.016)
Observations	1,621	1,136	1,612	1,127
R^2	0.08	0.259	0.105	0.276
F Statistic	139.432***	77.294***	185.285***	83.606***

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

Alternative Measures of Demographic Composition

Another potential issue of this study refers to the sensitivity of results to the operationalization of the main independent variable, specifically the age range used as a measure of the higher prevalence of individuals at young ages. As an additional analysis, I collected and processed two additional age indicators from the UN World Population Prospects. The first indicator measures the proportion of individuals between 15 to 24 years of age, as opposed to the broader age range between 15 to 29 years. The Pearson correlation between the percent of the population between 15 to

29 years of age, and between 15 to 24 years of age is of 0.924, which is very high and which is a consequence of the strong overlap between both measures. The second measure is the percent of the total population who are males and between ages 15 to 29, relative to the entire population of each country and year. The Pearson correlation between the percent males between 15 to 29 years of age, with the percentage of individuals of both sexes between 15 and 29 years of age is of 0.906.

Table 5.13 presents a replication of the fixed-effects regression models presented in Table 5.3, but replaces the percent 15 to 29 with the percent of the population between 15 to 24 years of age.

Table 5.12: Fixed Effects Models for the Average Effect of *Percent 15 to 24* on Homicide Rates

	High Coverage Sample		Long Series Sample			
	Since 1990	Since 1990	Since 1960	Since 1960	Since 1990	Since 1990
Percent 15 to 24	**1.050**** **(0.015)**	**1.030** **(0.018)**	**1.040*** **(0.020)**	**1.063***** **(0.017)**	**1.084***** **(0.023)**	**1.057*** **(0.026)**
Percent Male		1.036 (0.050)		1.113 (0.080)		1.153 (0.074)
Gini Index		0.987 (0.016)		0.961* (0.019)		0.959 (0.039)
GDP per Cap (1k)		0.970** (0.010)		0.996 (0.006)		0.984 (0.010)
Percent Urban		1.009 (0.009)		1.024* (0.009)		1.011 (0.017)
Observations	2,558	2,283	1,621	1,136	670	662
Countries	135	126	26	26	26	26
R^2	0.035	0.129	0.033	0.242	0.149	0.252
F Statistic	87.617***	63.913***	54.639***	70.405***	112.507***	42.528***

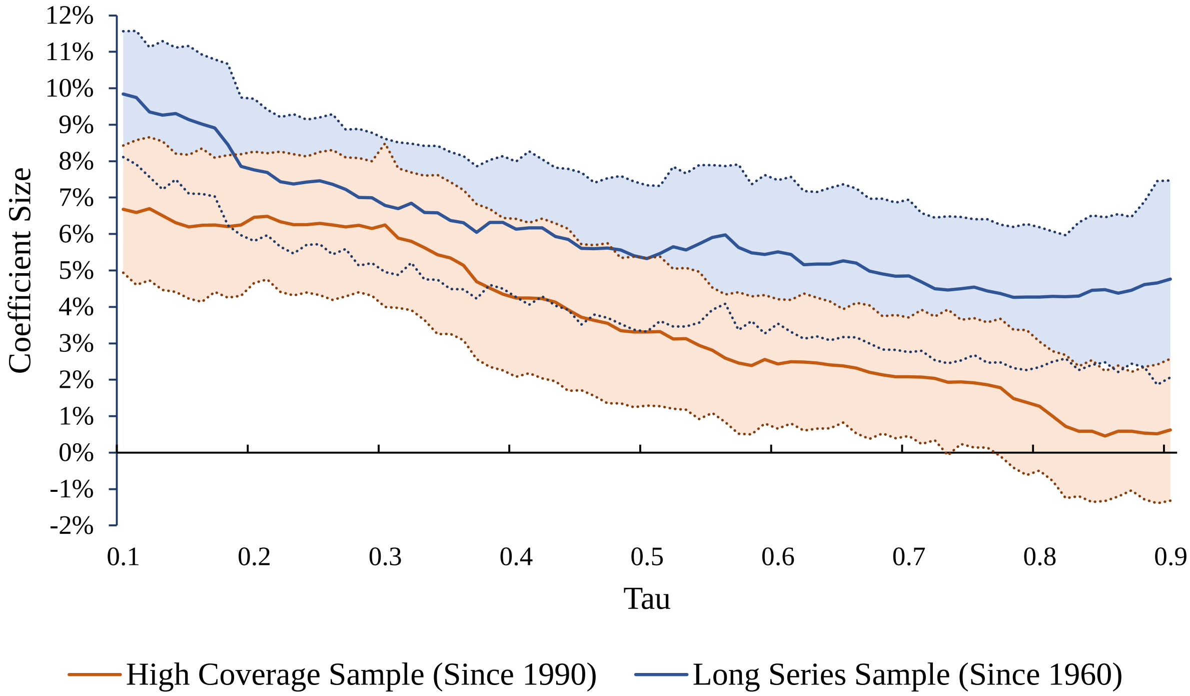
Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

Similar to the effect identified using the percent 15 to 29, the coefficient for the association between percent 15 to 24 and homicide rates is positive, and is much more pronounced in the Long Series Sample than in the High Coverage Sample when accounting for all other control variables. As in the main analytical model, the effect size of percent youth on homicide rates in the fully controlled model of the High Coverage Sample is not significantly different than zero. Finally, the effect identified in the Long Series Sample when using data since 1960 and data since 1990 is very similar, at about a 6% increase in homicide rate for each percentage point increase in the percent 15 to 24. Again, findings suggest that the differences between the Long Series and the High Coverage samples are related to the composition of the samples, instead of the number of years used.

Figure 5.7 replicates Figure 5.6, but replaces the percent of the population between 15 to 29 years of age with the percent of the population between 15 to 24 years of age. Coefficient sizes using the percent of the population between 15 and 24 years of age are generally higher across most of the distribution of homicide rates. These differences in effect, however, can be a consequence of differences in the effective range and in the distribution of both measures of age composition, an issue which will be explored later in this section.

Generally, effect sizes are relatively similar to those obtained using the percentage 15 to 29 in direction, size, and magnitude. Finally, similarly to previous analyses, there remains a trend of a decrease in effect size of percent young as the effect is evaluated at higher levels of the distribution of homicide rates.

Figure 5.7: Coefficient of the Percent 15 to 24 in Quantile Regression (with fixed effects) by (Ln) Homicide Rate Percentile and by Sample



Note: Confidence intervals correspond to an alpha level of 0.95.

Table 5.14 presents the same results as in Table 5.3, but replacing the measure of percent youth from the percent of individuals between 15 to 29 years of age, to the proportion of individuals who are males and between the ages of 15 and 29 years of age. Generally, the direction and significance of effects are very similar across measures of percent youth. The coefficient for percent male 15 to 29 in the High Coverage Sample decreases substantially with the inclusion of control variables. Furthermore, effect sizes in the Long Series Sample are much more pronounced and clear than the coefficients in the High Coverage Sample. Finally, when the Long Series Sample is restricted to only data since 1990, coefficients remain very similar as when data extends to 1960, again suggesting that the variation in effect between the High Coverage Sample and the Long Series Sample is a consequence of the country-composition of the Long Series Sample, as opposed to the use of a longer series of years.

Table 5.13: Fixed Effects Models for the Average Effect of Percent Male 15 to 29 on Homicide Rates[32]

	High Coverage Sample		Long Series Sample			
	Since 1990	Since 1990	Since 1960	Since 1960	Since 1990	Since 1990
Percent Male 15 to 29	**1.049** **(0.026)**	**1.026** **(0.028)**	**1.108***** **(0.026)**	**1.108***** **(0.026)**	**1.146***** **(0.030)**	**1.111**** **(0.041)**
Percent Male		1.027 (0.060)		1.105 (0.074)		1.130 (0.078)
Gini Index		0.989 (0.016)		0.967* (0.018)		0.962 (0.036)
GDP per Cap (1k)		0.968** (0.010)		0.997 0.000		0.986 (0.010)
Percent Urban		1.007 (0.009)		1.021* (0.009)		1.014 (0.016)
Observations	2,559	2,283	1,621	1,136	670	662
Countries	135	126	26	26	26	26
R^2	0.018	0.123	0.088	0.259	0.203	0.277
F Statistic	43.474***	60.307***	153.727***	77.331***	164.105***	48.321***

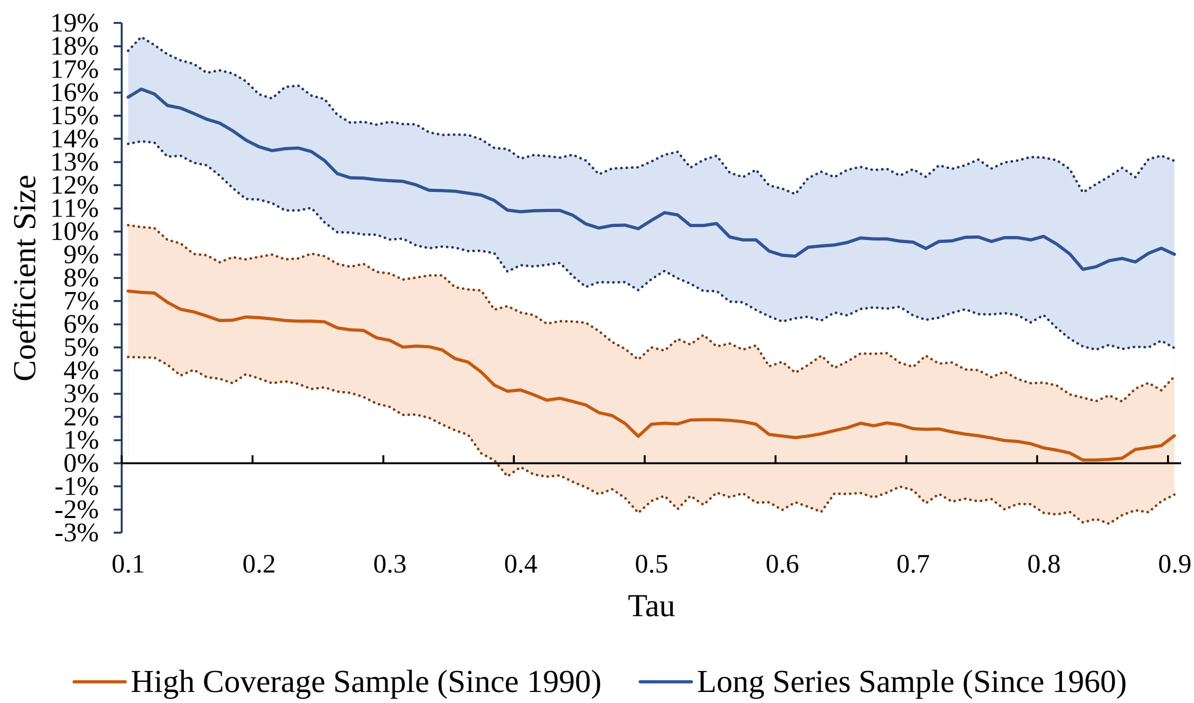
Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

Figure 5.8 illustrates variations in the effect of percent males between 15 to 29 years of age across homicide levels by utilizing the same quantile regression as employed with the other two measures of percent youth. Results indicate the same pattern of an increased effect for countries and years at the lowest distribution of

[32] Models were also executed by removing the Percent Male as a control variable, and results did not vary substantially. Results presented kept the percent male to maintain comparability with the models using the other measurements of age composition, and because it did not introduce major issues of multicolineary (VIF = 2.23).

homicide rates, coupled with a decrease in the coefficient size as the association is evaluated at higher levels of the distribution of homicide rates. One particularity of the percent males 15 to 29 is the differences between the effect sizes obtained using the High Coverage Sample and the Long Series Sample, as the differentiation is more clearly delimited across the entire distribution of homicide rates. Moreover, as with the percent 15 to 29, the effects at the High Coverage Sample are only clearly distinguishable from zero at lower levels of the homicide rate distribution. At the first decile (tau = 0.1) each additional unit increase in the percent of males between 15 to 29 years of age corresponds to an increase of 7.3% in the homicide rate. However, at the 9th decile that coefficient is almost 10 times smaller, at approximately 0.75%. These differences in effect mirror those identified using the other measures of percent youth.

Figure 5.8: Coefficient of the Percent Males between 15 to 29 in Quantile Regression (with fixed effects) by (Ln) Homicide Rate Percentile and by Sample



Note: Confidence intervals correspond to an alpha level of 0.95.

Generally, the effect sizes of the percent of males between 15 to 29 years of age are much stronger than the same effects identified using other measures of percent youth. For instance, while the coefficient for the percent male 15 to 29 in the fully controlled model using the Long Series Sample is of 1.108 (10.8%), the same coefficient using the percent 15 to 24 years is of 1.063 (6.3%), and using the percent 15 to 29 only is of 1.054 (5.4%).

While these differences could be interpreted as an indication that sex-specific age composition has a more notable impact on homicide trends than age composition alone, the differences in coefficient sizes across the three measures of percent youth can also be a consequence of differences in the effective range and in the distribution of each one of these variables. Hence, the direct comparison between effect sizes requires the calculation of standardized coefficients. As opposed to all previous models, in the present analysis all variables were standardized in a z-score scale (with a mean of zero, and with each unit corresponding to one standard deviation) prior to their inclusion in the model. Hence, coefficient sizes are in a standardized scale, and are directly comparable.

Table 5.15 directly compares the coefficient sizes across the three different measures of percent youth explored in the current study. The first three models were executed using the High Coverage Sample (since 1990), while the latter three models were executed using the Long Series Sample (since 1960).

As results show, coefficient sizes are higher for all three measures in the Long Series Sample than in the High Coverage Sample. However, most relevant for this analysis is the similarity between coefficient sizes across all three measures of percent youth. All coefficients in the High Coverage Sample are not significantly different from zero, and from each other. According to the results using the Long Series Sample, an increase of one standard deviation in the percent 15 to 29 is related to an average increase of 13.4% in the standard deviation of the homicide rate. That estimate has a 95% confidence interval between 6.1% and 21.2%. That same coefficient equals 13.0% (with a 95% confidence interval between 5.9% and 20.6%) for the percent 15 to 24 years of age, and is somewhat higher for the percent of males between 15 to 29 years, at 16.1% (with a 95% confidence interval between 7.8% and 25.1%). None of the coefficients are clearly distinguishable from the others in size nor in dispersion.

Table 5.14: Fixed Effects Models Comparing the Average Effect of Percent Youth on Homicide Rates by Measures of Demographic Composition – *Standardized Coefficients*

	High Coverage Sample			Long Series Sample		
	Since 1990	Since 1990	Since 1990	Since 1960	Since 1960	Since 1960
Percent 15 to 29	**1.044** **(0.037)**			**1.134***** **(0.034)**		
Percent 15 to 24		**1.061** **(0.035)**			**1.130***** **(0.033)**	
Percent Male 15 to 29			**1.038** **(0.041)**			**1.161***** **(0.038)**
Percent Male	1.065 (0.104)	1.072 (0.098)	1.053 (0.118)	1.262 (0.149)	1.236 (0.157)	1.218 (0.146)
Gini Index	0.925 (0.113)	0.913 (0.114)	0.924 (0.113)	0.794 (0.129)	0.762* (0.134)	0.792 (0.127)
GDP per Cap (1k)	0.698** (0.116)	0.703** (0.111)	0.689** (0.116)	0.961 (0.065)	0.956 (0.068)	0.964 (0.065)
Percent Urban	1.170 (0.180)	1.191 (0.182)	1.154 (0.180)	1.539* (0.181)	1.592* (0.183)	1.515* (0.181)
Observations	2,558	2,283	2,283	1,136	1,136	1,136
Countries	126	126	126	26	26	26
R^2	0.125	0.129	0.123	0.259	0.242	0.259
F Statistic	61.538***	63.913***	60.307***	77.294***	70.405***	77.331***

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

In conclusion, while there are conceptual and empirical implications in the choice of a measure of demographic composition, the directly observable impact of various measurement choices are similar enough to support the conclusion that findings are not sensitive to the choice of one particular independent variable over the others. Nonetheless, differences across these, and other potential indicators for demographic composition should be explored by extant research, in particular by investigating the role of gender, and its interaction with age in dictating homicide trends.

Youth Cohort Size Relative to Older Age Groups

At the macro level, there are two main theories which predict an effect of age composition on homicide rates. In addition to a *Simple Aggregate Effect,* other theoretical propositions have argued that crime trends may be impacted by the size of the youth cohort relative to older age groups. These propositions are part of a broader *Relative Cohort Size* perspective, which generally posits that members of larger cohorts, particularly when they are young, suffer a range of disadvantages and increased competition which impact the quality of the public services provided to them, restrict their labor market opportunities, and decrease the amount of supervision provided to them by older age groups (Cook & Laub, 2002; Easterlin, 1978, 1987; O'Brien et al., 1999; Steffensmeier et al., 1992).

The current analysis replaces the percent 15 to 29 with measures of the size of the youth cohort group over the ages above that age group. Table 5.16 contains the results of this analyses divided in eight models. The first four correspond to the effect of the percent of the population at 15 to 29 years of age over the size of the population between 30 to 59 years on homicide rate. The second four models utilized instead the ratio between the population ages 15 to 24 years, over the population between 25 to 59 years. On average, controlling for all other country level characteristics, each increase of one percentage point in the ratio of the population between 15 to 29 years of age over the population between 30 to 59 years of age is associated with an increase of 0.4% in the homicide rate of countries in the High Coverage Sample, and of 0.7% in the homicide rate of countries in the Long Series Sample. For the ratio between the ages 15 to 24, over the ages between 25 to 59, each increase of one percentage point corresponds to an increase of 0.9% in the homicide rate of countries in the High Coverage Sample, and of 1.1% in the homicide rate of countries in the Long Series Sample.

Generally, results indicate very small and indistinguishable effects of each measure of relative cohort size on homicide trends, regardless of the exact age groups used or the sample of countries.

Table 5.15: Fixed Effects for the Average Effect of Relative Cohort Size on Homicide Rates

	Ages 15 to 29 Over 30 to 59				Ages 15 to 24 Over 25 to 59			
	High Coverage Sample		Long Series Sample		High Coverage Sample		Long Series Sample	
	Since 1990	Since 1990	Since 1960	Since 1960	Since 1990	Since 1990	Since 1960	Since 1960
Ages 15 to 29 / 30 to 59	**1.008**** **(0.003)**	**1.004 (0.003)**	**1.002 (0.005)**	**1.007 (0.005)**				
Ages 15 to 24 / 25 to 59					**1.014**** **(0.004)**	**1.009 (0.005)**	**0.999 (0.008)**	**1.011 (0.009)**
Percent Male		1.037 (0.050)		1.113 (0.082)		1.037 (0.048)		1.117 (0.080)
Gini Index		0.987 (0.016)		0.960* (0.020)		0.985 (0.016)		0.957* (0.019)
GDP per Cap (1k)		0.968*** (0.010)		0.991 (0.007)		0.969*** (0.009)		0.991 (0.007)
Percent Urban		1.011 (0.010)		1.028*** (0.008)		1.012 (0.010)		1.027*** (0.008)
Observations	2,558	2,283	1,621	1,136	2,558	2,283	1,621	1,136
Countries	135	126	26	26	135	126	26	26
R^2	0.029	0.124	0.002	0.206	0.030	0.128	0.0001	0.201
F Statistic	71.942***	60.716***	3.583	57.338***	75.029***	63.085***	0.146	55.596***

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

Table 5.17 uses standardized coefficients to enable the direct comparison between coefficient sizes of each of the above measures of relative cohort sizes, and of the original measure of age composition used in this study – the percent of the population aged 15 to 29 years over the entire population size. Specifically, the standardization is necessary because each of the original measures of age composition do not have the same effective range and distributions. Thus, the effect of a change of one-unit in any of the three measures is not directly comparable to each other without the use of standardization.

Results from these analyses confirm the lack of an effect of both measures of relative cohort size on homicide trends with the inclusion of the control variables, both when using the High Coverage Sample and the Long Series Sample. However, results from the long series sample indicate that the absence of effect in that sample is not a consequence of a small average association, but is instead caused by an increase in the variability of the coefficients when compared to the standard error of the original age composition measure.

Regardless, while findings indicate similarity in the average relationship across all measures in the Long Series Sample, differences in variability suggest that the percent of the population between 15 to 29 years of age is more appropriate for identifying the effect of age composition on homicide trends than alternatives indicators of relative cohort size.

Table 5.16: Fixed Effects for the Average Effect of Relative Cohort Size on Homicide Rates – *Standardized Coefficients*

	High Coverage Sample			Long Series Sample		
	Since 1990	Since 1990	Since 1990	Since 1960	Since 1960	Since 1960
Ages 15-29 over Total	**1.044** **(0.037)**			**1.134*** (0.034)**		
Ages 15-29 over 30-59		**1.075** **(0.066)**			**1.138** **(0.100)**	
Ages 15-24 over 25-59			**1.105** **(0.057)**			**1.121** **(0.093)**
Percent Male	1.065 (0.104)	1.074 (0.098)	1.075 (0.094)	1.262 (0.149)	1.236 (0.162)	1.245 (0.159)
Gini Index	0.925 (0.113)	0.913 (0.113)	0.901 (0.113)	0.794 (0.129)	0.753* (0.136)	0.737* (0.133)
GDP per Cap (1k)	0.698** (0.116)	0.689*** (0.112)	0.695*** (0.109)	0.961 (0.065)	0.904 (0.083)	0.903 (0.083)
Percent Urban	1.170 (0.180)	1.228 (0.190)	1.261 (0.194)	1.539* (0.181)	1.703*** (0.157)	1.693*** (0.159)
Observations	2,283	2,283	2,283	1,136	1,136	1,136
Countries	126	126	126	26	26	26
R^2	0.125	0.124	0.128	0.259	0.206	0.201
F Statistic	61.538***	60.716***	63.085***	77.294***	57.338***	55.596***

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

In my interpretation, findings of these analyses should not be understood as an indicator that perspectives related to a *Simple Aggregate Effect* are superior to *Relative Cohort Size* theories in explaining the relationship between age composition and homicide trends. Instead, I argue that the underlying mechanism described by each of the theories likely operate in combination in determining the impact of age, and in explaining effects obtained for all age measures used in the current study. A higher proportion of individuals at younger ages can impact crime simply by generating an increase in the proportion of individuals at crime-prone ages. In addition, an added consequence of this high proportion of youth is an increase in competition for resources, an increase in political alienation from the rest of society, a reduction in the quality of services received, and in the supervision provided by older age groups. Hence, the underlying mechanisms proposed by both theories can clearly operate in combination to explain an age effect. Clearly distinguishing the impact of each of these mechanisms would require high-quality data on the quality of public services, labor market conditions, the degree of alienation of a population (by age group), or at least data on the amount of supervision provided by the older cohorts to younger cohorts. Furthermore, such data would need to available at a global scale and longitudinally. Such data is simply unavailable, and while proxies may exist, their use must be subject to extensive discussion and empirical test.

Given the characteristics of the current research, there seems to be no compelling reason for contrasting these two theories against one another. In fact, I believe this exercise may result in a false dichotomy, in which theories are put to compete when they may simply be explaining an entirely different phenomenon, or when they are trying to explain the same phenomenon, but under a different perspective (Bernard & Snipes, 1995). Hence, theory competition is not always useful for the development of a scientific understanding of social forces, in particular when these theories' propositions and assumptions must not necessarily contradict each other – as is the case of the current analysis (Elliot et al., 1985; Messner et al., 1989).[33]

Nonetheless, future research should continue to seek better data, and to parse out the components of the effect of age composition on homicide trends. I believe both the *Simple Aggregate Effect* and the *Relative Cohort Size* theories offer useful insight in guiding this work. While the current research simply argues that age matters (and explores the circumstances when and where it matters), future studies can make meaningful developments by exploring *why* exactly age matters. The result of this research may lend support for either of the two theories described in this study, a combination of them, or to novel propositions.

Missing Data

Another potential issue related to the models used in the current study is the presence of missing data on the indicators used in the analyses. This is a serious methodological issue that was approached through several different strategies. First,

[33] For some rich debate regarding theory competition and integration in criminology also see Elliott et al. (1979); and Hirshi (1979).

results should not be automatically extrapolated to countries and years not included in each of the analytical samples (listed in Appendix C). While the high coverage of the analytical sample of the current study supports the external validity of the findings, the systematic aspect of the missing data, and the differences in the probability of certain years and countries of being absent from the sample may introduce bias to the estimates.

A second strategy was the execution of a range of analyses which show the resilience of effects to variations in the specifications of the regression models used in the current study. A first evidence for robustness is the fact that the same pattern in the relationship between age composition and homicide rates was observed both in the High Coverage and in the Long Series sample, each with very distinct composition in terms of the countries and in the years included. A second evidence for robustness is the fact that coefficient sizes are quite similar between the bivariate, and the fully controlled models using the Long Series Sample, despite the decline in sample size due to the inclusion of more covariates.

As an additional sensitivity analyses to assess whether results were influenced by missing data on the control variables, I estimated two additional models evaluating the bivariate relationship between percent 15 to 29 on homicide rates, but restricting the sample only to the observations with available data on all covariates. That restriction reduced the sample size from 2,558 observations in the High Coverage Sample, to 2,283 observations. The Long Series Sample is reduced from 1,621 to 1,136 observations.

The results presented in Table 5.18 demonstrate that the coefficient sizes of the percent young using the restricted samples are substantively similar to those reported in the main bivariate analysis. In the High Coverage sample, the coefficient size increases from 1.038 to 1.050. In the Long Series Sample, the coefficients are virtually the same, with an increase from 1.051 to 1.053. This analysis provides additional support that the core findings are not substantively affected by changes in the sample composition due to missing data on controls.

Table 5.17: Sensitive Analysis Restricting the Bivariate Models to the Fully Controlled Sample of Observations

	High Coverage Sample			Long Series Sample		
	Since 1990	Since 1990	Since 1990	Since 1960	Since 1960	Since 1990
Percent 15 to 29	**1.038****	**1.018**	**1.050*****	**1.051*****	**1.054*****	**1.053*****
	(0.013)	**(0.015)**	**(0.014)**	**(0.014)**	**(0.014)**	**(0.011)**
Percent Male		1.032			1.125	
		(0.053)			(0.075)	
Gini Index		0.989			0.967	
		(0.016)			(0.019)	
GDP per Cap (1k)		0.969**			0.997	
		(0.010)			(0.006)	
Percent Urban		1.008			1.022*	
		(0.009)			(0.009)	
Observations	2,558	2,283	2,283	1,621	1,136	1,136
Countries	135	126	126	26	26	26
R^2	0.032	0.125	0.052	0.08	0.259	0.132
F Statistic	80.688***	61.538***	117.915***	139.432***	77.294***	168.597***

Note: *p<0.05; **p<0.01; ***p<0.001. Coefficients are exponentiated, and correspond to the average proportional change in the geometric mean of homicide rate from a one-unit increase in an independent variable, relative to the previous unit.

Summary of Findings and Research Questions

This section explicitly links results from the analysis of the present chapter to the research questions and hypotheses outlined in Chapter 3.

The first research question was an inquiry about the existence of an average effect between changes in age composition and homicide rates. Analyses related to this question generally did not find a clear association between percent youth and homicide rates using the High Coverage Sample. In contrast, an effect was both notable and clear in the models that utilized the Long Series Sample. Additional analyses indicated that differences in effect between the samples were related to the composition of each sample in terms of countries included, instead of the size of the series of each sample – a finding which was considered indicative of the existence of heterogeneity in the effect of percent youth across country-level characteristics (see Table 5.3). In conclusion, results provide only mixed support for the hypothesis that the directly observable effect of percent youth on homicide rate is positive and above zero. Instead, findings indicate that the effect of age composition on homicide trends is nuanced, and may not be effectively summarized by a single average estimate.

Additional analyses also sought to contextualize estimates in the relationship to the International Homicide Decline. As presented in several of the above analyses, coefficient sizes were often estimated at around 5% more homicides for each increase of one point in the percent of the population between 15 to 29 years of age.[34] As several countries and regions are experiencing declines of their percent young of several percentage points, the aging of populations globally seems to be strong enough to support an international homicide decline. Moreover, an association between age composition and homicide rates is apparent across most regions of the

[34] The quantile regression models using the High Coverage Sample yielded effects between 5.94% and 0.2%.

world, with the exception of the region where homicide rates is highest, and which is not participating in the International Homicide Decline. Generally, findings suggest that the effect of age composition may be broad enough, and strong enough to explain an international decline in homicides.

The second research question evaluated the presence of variation in the impact of age composition across regions. Once again, findings provided only mixed support for the hypothesis that effect sizes vary across regions. When using the fixed-effects regression models with an interaction term for each region, no differences in effect were identified while using the High Coverage Sample, but notable differences were observed when models used the Long Series Sample. In the latter, findings indicated sizable effects of percent youth on homicide rates in Eastern Europe, Asia, Northern America and Western Europe. Of the remaining three regions (Oceania, Latin America, and Africa), two contain several of the countries with the highest rates of homicide in the world.

The third research question explored variations in the effect of percent youth across the level of social and political stability of countries. Analyses using the State Fragility Index (Table 5.9 and Figure 5.5) with the High Coverage Sample show a positive effect of percent youth on homicide rates at the lowest levels of State Fragility, and a gradual decline in effect at higher levels of State Fragility. Hence, findings provide support for the hypothesis that the effect of age is stronger for countries with lower levels of instability, and weakens gradually as country stability increases.

Finally, a fourth research question investigated variations in the effect of percent youth across levels of homicides, under the hypothesis that the effect of age is stronger for countries with lower levels of homicide, and weakens gradually as homicide rates increase. Findings were supportive of this hypothesis, as results show that the effect of age composition is progressively stronger as it is evaluated for the countries with the lowest levels of homicides in the world. In contrast, as homicide rates increase, the effect of age composition becomes progressively weaker. Declining effects across the homicide distribution were observed both in the High Coverage Sample and in the Long Series Sample. Moreover, in the High Coverage Sample, the effect of percent youth actually approximates zero at around the median of the homicide rate distribution.

As a summary, the following table contains a description of the research questions of this study, of the hypothesis proposed for each research question, and of related research findings.

Table 5.18: Summary of Research Questions, Hypotheses and Results

Research Question	Hypothesis	Results
1. Is there an average effect of percent youth on homicide trends?	The average effect of percent youth on homicide rate is positive and above zero.	Mixed Support. An average effect of percent youth was found in the Long Series Sample, but not in the High Coverage Sample. Results suggested that the effect of age composition is conditional on sample composition and on other country-level characteristics.
2. Are there variations in the impact of percent youth across regions?	The average effect of percent youth on homicide rate varies by region. Moreover, that effect is positive and above zero for the regions which experienced homicide declines.	Mixed Support. There are clear variations in the bivariate correlations between the trends of percent youth and homicide trends. Differences in effect were identified in the Long Series Sample, but not as clearly in the High Coverage Sample.
3. Is the effect of percent youth on homicide trends conditional on the level of state fragility of countries?	The effect of age composition on homicide trends is conditional on the level of state fragility of countries. In particular, the effect of age is stronger for countries with lower levels of instability, and weakens gradually as country instability increases.	Positive Support. The effect of percent youth on homicide percent youth is positive for countries with a State Fragility Index of zero. Moreover, the effect of age reduces as country instability increases.
4. Is the effect of percent youth on homicide trends conditional on the level of homicide of countries?	The effect of age composition on homicide trends is conditional on the level of homicide of countries. In particular, the effect of age is stronger for countries with lower levels of homicide, and weakens gradually as homicide rates increase.	Positive Support. The effect of percent youth on homicide percent youth is positive for countries at the lowest percentiles of the homicide rate distribution Moreover, the effect of age reduces as homicide rate level increases.

Generally, findings provide support for the conclusion that an effect exists between age composition and homicide trends. However, findings also indicate that this relationship is much more nuanced than previously thought. In particular, the presence of a directly observable effect of age composition on homicide trends is conditional on the absence of instability and on the level of homicide of countries. Specifically, differences in the effect of age composition were shown across regions, by level of state fragility, and by level of homicides. While each of these sources of heterogeneity correspond to a distinct country-level factor, I argue that they may share a common explanation, as each may be an expression of the *concentration of disadvantages* experienced by countries. Generally, these findings are indicative that the presence of a directly observable effect of age composition on homicide rate is conditional on the absence of competing criminogenic forces driving the homicide trend.

There are several ways to interpret this particular finding. I extrapolate from my empirical findings to propose that it is not the effect of age composition which disappears. Instead, it may simply be that this effect is no longer distinguishable from other criminogenic forces driving homicide rates higher.[35] That argument entails that as the level of violence increases, the impact of age becomes secondary to all other drivers of violence. That was the case during the crack epidemic in the United States, as it was the case during the social and political chaos which followed the dissolution of the Soviet Union. Moreover, that is very likely the case of present day Latin

[35] The effect of age, I argue, may be similar to gravity. Its influence may be always present, but it can also be negated and/or defied by competing forces.

America - the stage of numerous social, political and economic crises. Whenever these crises recede, and as they lose grip on dictating homicide trends, the influence of demographic shifts is likely to become more apparent.

Chapter 6: Conclusions

Overview of Findings

Considerable scientific effort has been devoted to understanding crime trends in both the United States and abroad. Still, scientific knowledge lacks a coherent explanation for changes in homicide rates overtime. In the current study, I attempted to shift the search of the causes of homicide trends away from an exclusive focus on domestic policies and events of individual countries, to broader global phenomena.

By definition, homicides involve intentionality – they consist of one individual's decision to kill another. However, despite the nuances and details of individual crimes that are seemingly unrelated, ultimately homicides are influenced and supported by macro-level forces which exist beyond the will of individuals (Durkheim, 1952). These forces can have strong influences on the prevalence of violent crimes across societies. At times, they may even have the strength to be felt globally. For instance, some have argued for a global political shift to the right (Cusset, 2018). National elections in western democracies that are seemly unrelated to each other (e.g. United States, Brazil, Austria, France, Germany, Hungary), are repeatedly showing an increased strength of political movements associated with right-wing views, some of which were marginalized just a decade ago.[36] Other

[36] Interestingly, elections could also have been influenced by worldwide shifts in age composition, as older individuals are generally more likely to hold conservative political views associated to the right.

authors have pointed out to a global increase in inequality, driven by international economic forces, including the decrease in the value of labor, and a reduction in the risks associated with capital ownership (Dicken, 1998). Every day, global markets impact each other in such a way that a citizen of the United States has a material economic stake in the prosperity of the citizens of China, and vice-versa. In the current study, I presented several international demographic trends that are resulting in an aging of global populations. In such an interconnected world, it is plausible to consider that social variables can have international causes. Crime is no exception.

In reality, the influence of macro-level phenomena on homicide trends is very often ignored. As in the United States, authorities from countries worldwide claimed ownership for their own homicide trends, often linking the decline to domestic causes or to policies of their own making (Bratton & Kelling, 2015). In this study, I argue that while such policies can indeed have a meaningful impact on the rates of homicides and violence, estimates of these impacts must account for the influence of major macro-level forces which are influencing populations globally. A failure to take this approach may erroneously attribute a change in crime to policies that are costly, but ineffective.

Starting from international demographic research on the changing age-structure of the global population and criminological research linking age as a primary correlate of criminal activity, this study proposes that changes in country-level age structure may explain cross-national homicide trends, including the international homicide decline. Generally, the wealth of evidence presented by the current study supports this proposition. The percentage of a country's population aged

15 to 29 is a robust predictor of global homicide trends since the 1960s. Furthermore, the estimated effect is strong enough to justify the declines in homicides which were felt internationally. Finally, an effect of age composition is observed across the countries and regions that have participated in the international homicide decline, with enough generality to justify the commonality of their trends.

Therefore, the wealth of evidence in the current study strongly supports the conclusion that the aging of populations globally has been a major cause of the international homicide decline. As populations continue to grow older, as implied by current demographic trends, there are likely to be even greater declines in homicide rates internationally.

Hence, there seems to exist a pacifying process as a direct consequence of an aging population. However, this study also presents evidence that this effect is not universal. To the contrary, the effect of demographic forces can be suppressed by the influence of other criminogenic forces exerting much greater influence on homicide trends in a particular place, or at a particular time. Specifically, the current study explored variations in the association between age composition and homicide rates across levels of State Fragility and across levels of homicide. Both variables were used as measures of the confluence of extant criminogenic forces. Their corresponding analyses generated evidence that as other risk factors for violence gain strength, the direct impact of age gradually diminishes. Thus, this study demonstrates that the influence of age on homicide trends is more apparent in countries with the lowest levels of homicide and with higher levels of social and political stability. In contrast, as violence and instability increases, the age effect is attenuated.

I argue that the absence of a directly observable relationship does not necessarily imply that a relationship does not exist, but simply that, at times, it cannot be observed directly using traditional methods, and without the appropriate control variables to account for extant criminogenic forces. Returning to the example of the United States, the crack epidemic generated an enormous loss of life. However, once the epidemic receded, the homicide rate did not return to the level prior to the epidemic, of 7.7 in 1985. Instead, homicides continued to decline to a rate of 5.5 in 2000, when homicides resumed the relationship they had to the percent youth prior to the epidemic. As the percent youth decreased between 1985 and 2000, homicides changed accordingly.

This interpretation of the findings implies that the impact of demographics on homicide trends is uninterrupted, but that it may be omitted when age becomes secondary to the influence of other drivers of homicide trends. This conclusion also implies that the homicide rate of Latin America could be even higher than they are currently, was it not for the aging of the region's population, and that demographic shifts will continue to place increased pressure on the rates of violence in that region, and around the world.

It should be noted that this interpretation of results is entirely theoretical, and has no parallel in extant macro-level research which I could identify. The current study traces a macro-level parallel with the micro-level concept of *disadvantage saturation* found in the literature on individual risk factors for crime (Hannon, 2003; Kahlmeter et al., 2017; Raine, 2002), to propose that countries may also experience a similar process of *concentrated disadvantage*. Specifically, countries experiencing high levels of social, political, or economic disadvantage are more likely to experience many other disadvantages in combination. Those may include high levels of poverty, inequality, unemployment, political unrest, instability, the inefficacy of criminal justice institutions, challenges in public health and in education, as well as high levels of violence. Within the conceptualization of *concentrated disadvantage*, homicides may be interpreted as just one more societal issue, which will emerge both as a consequence, and in combination with other country-level disadvantages.

I argue that the concept *concentrated disadvantage* adequately explains inconsistencies of previous research, in addition to the findings of the current study. In particular, it is able to account for the lack of an observable effect of individual drivers of homicides, when other drivers gain prominence. Hence, while age composition may be key in explaining the international homicide decline and crime trends more generally, the effect of population aging may be omitted by concentration of other disadvantages driving the changes in homicides in a given country, and during a certain period.

It should also be noted that alternative explanations for my findings are possible, and that the current research does not seek to disprove all competing explanations. There may be other reasons, besides *concentrated disadvantage*, as to why age composition has no impact on crime trends among countries in Latin America, with high levels of State Fragility, or with high levels of homicide. Future research should contrast the proposition of the current study with alternative explanations which are able to explain the variations in effects identified in the current study.

Limitations and Future Directions

This study has several limitations that can be the basis of future research. First, several country-level measures that are typically employed as control variables in cross-sectional comparative homicide research could not be included in the analyses, such as divorce rates, ethnic homogeneity, or female labor participation (Nivette, 2011). As these measures are only available for a small subset of countries and years, including them would drastically reduce sample sizes, and would limit the sample to mostly developed democracies in Europe and North America, and to a shorter frame of time encompassing only recent decades. These sample restrictions would be much more harmful to the usefulness of this study and to the validity of findings than the omission of control variables.

Several methodological decisions minimized or accounted for the risk of omitted variable bias. First, a fixed-effects model accounts for unobserved time-stable characteristics of each country that could introduce bias into the relationship between age composition and homicide rates. Second, control variables for time-varying characteristics of countries were included in the analyses. Third, as the social and economic indicators of countries tend to be very highly correlated (Pridemore, 2008; Rogers & Pridemore, 2017), the control variables included in the analyses are likely to partially capture other features of each country which were not explicitly included as controls. Finally, sensitivity analyses were performed with alternative model specifications to test for the influence of omitted variable bias in the results, with no indication thereof. Future analyses should attempt to test the robustness of findings to alternative model specifications, and to the inclusion a wider range of country-level characteristics as controls in the regression models.

A second limitation is the lack of reliable homicide data for many countries prior to the 1990s. On that point, the Long Series sample (since 1960) was limited to a subset of 26 mostly developed, high-income countries. Future research can extend this study by investigating the role of age on homicide trends using a more comprehensive set of countries, and a longer series.

Third, this study focused on the role of percent young (aged 15-29) on influencing homicide trends. This age range was chosen as it encompasses the crime-prone ages (Hirschi & Gottfredson, 1983), and because that range was broad enough to accommodate variations in the age and crime curve of countries (Steffensmeier et al., 2018). In addition, I performed additional analyses evaluating the sensitivity of findings to an alternative operationalization of percentage youth. Findings from these analyses show that different measures of percent youth are usually highly correlated to each other, and that the relationship between age composition and homicide trends seems relatively unaffected by the choice of one particular measure. Still, future work can further assess the sensitivity of current findings to alternative operationalization of age structure.

Fourth, the current study focused on the influence of age on trends of homicide, as opposed to other violent crimes and property offenses. Given the lack of reliable international crime statistics, homicide is generally considered the most accurate measure of crime in a cross-national context (LaFree, 1999; Lynch & Pridemore, 2011). Future research should investigate the association between age composition and the rates of other forms of criminal activity. In particular, interesting variations may exist in the association between age composition, violent crimes, and property crimes. As property crimes are distinguished by their motivation for enrichment, their trends may entail very different causal processes than homicides, which may or may not be as closely related to a youthful population. While comparative data on other crimes besides homicides is scarce, and of questionable quality, creative data collections strategies such as the International Crime Victimization Survey (ICVS) might provide the means to expand this line of research.

Concerns about data quality are also a limitation of the current study. Chapter 4 describes in detail the sources of data on homicides, and the procedures performed by the UNODC and the WHO in order to ensure, to the extent possible, that the data published by the respective organizations is valid. I also provided arguments in support of the validity of the data, including the longitudinal and geographic consistency of values, the agreement between published values that draw from distinct and independent primary sources, and the substantive validity of homicide counts. However, despite these arguments, the fact is that neither the UNODC nor the WHO nor the academic community in general is certain of the quality of cross-national homicide counts. I would argue that this fact is also true for almost any other data source, including surveys, and that social researchers should always be cognizant of the risks measurement error poses to the internal validity of the findings obtained (Sherman, 2002). In addition, social research itself should attempt to estimate the error structure associated with its data sources. For instance, several high-homicide countries in the world also experience high rates of disappearances of persons who are often connected to organized crime or to the drug trade (Gamlin, 2015). A large proportion of these disappearances may actually be homicides of individuals whose bodies are hidden from the public and from authorities. As the death was never recorded, it never generated a death record in the public health system or a crime record in the criminal justice system. Therefore, it introduces a bias in the final homicide count of these countries. A second example relates to the intentionality and the clarification of killings. A recorded suicide can potentially be a homicide committed by an offender who was never caught. In other cases, a recorded homicide might be the result of an act of self-defense, but which was committed by a perpetrator who was too suspicious of authorities to ever report the incident, or who was unaware of one's right to self-defense.

The actual impact of these biases on estimated relationships should be relatively small. This is particularly the case because countries with an increased prevalence of disappearances and with low clarification rates are likely the countries with the highest homicide rates. In relative terms, these added killings might correspond to a fraction of all homicides that are already recorded. Moreover, the use of a log transformation of homicide rates minimizes the influence of extreme values on estimated coefficients. Hence, even if the aforementioned issues did exist, the relative ranking of countries in regards to their homicide rates should remain largely unaltered, as would the differences in the log-transformed homicide rates. It should be noted however, that this last point is a speculation. Future research should attempt to identify and to address sources of error in the measurement of homicides, and of all variables used in the current study. This search for better data, however, is a continuous process with no end in sight, which should not limit the endeavors to use these data for research purposes.

Finally, one last limitation is this study's inability to test, and to account for all alternative explanations for the United States', and for the International Homicide Decline. The current study never presumed to be a comprehensive investigation of all hypotheses. However, a possible challenge to findings and conclusions presented in this dissertation is that all trends and relationships found are a product of a third unknown factor, and that the association between age composition and homicide rates is merely incidental. The current study provided arguments that I believe were logically formulated, and that were well supported by both theory and by a wealth of empirical evidence. Nonetheless, future research should resume the investigation of the causes for the international decline, and for changes in homicide trends more generally. That pursuit can entail the identifying and addressing of limitations of the current study, or the proposing of alternative explanations for the trends and associations I identified.

Implications for Criminology

The findings and conclusions of this study hold several important implications for the study of crime trends, and for criminology in general. First, for researchers, these findings provide evidence that demographic pressures deserve special attention, and that social scientists' focus on age when explaining crime is largely justified. This conclusion stands in contrast to extant research that proposes age structure is unrelated to country-level crime rates (Levitt, 1999, 2004; Rogers, 2014; Rogers & Pridemore, 2016, 2017). Rather, my work suggests that the individual relationship between age and criminality is also central to the understanding of the causes of changes in crime trends over time. Researchers should take advantage of this strong link for developing macro-level theories of crime, particularly dynamic theories (Sampson & Laub, 1997) that are able to explain the causes of changes in crime rates over time, as opposed to only the differences in crime rates between places. The social sciences still lack a comprehensive explanation for why crime rates change. I argue that this comprehensive explanation should pay particular close attention to age composition, even if mediated by extant factors. However, age is certainly not the only cause for change, even among the most stable and safe countries of the world. The development of a complete causal model of crime trends, if ever possible, will likely require very extensive research, by many experts.

Whichever causal model that is, it may need to account for the role *concentrated disadvantage*, specifically by taking note, and by exploring the interactions between country-level disadvantages in explaining violence. Furthermore, researchers must be cognizant of the challenges of identifying the influence of individual causes of violence in the presence of the confluence of several other disadvantages – most of which are either unknown to the literature, or have no available measures at the international level which can be used as statistical controls.

One particular disadvantage which is deserving of more detailed consideration is the role of political instability, in particular when it translates into states' inability to effectively provide basic services or to maintain some amount of order - often amounting to a collapse in political institutions and of civil society more generally. An increase in political instability may be particularly concerning at times of change, such as the broad transitions experienced by Eastern Europe during the 1990s. It may also be an ongoing problem across many countries in Latin America, which face a range of social and political problems, some of which are beyond governments' ability to address them. On a preliminary basis, I directly addressed this discussion when investigating how State Fragility moderated the effect of age composition on homicide trends, an analysis which indicated for the preeminence of the concept of *political efficacy and stability* in explaining violence, and more generally as a signal for the concentration of several other disadvantages in a given country.

In fact, high levels of homicides are also strongly indicative of the presence of social and political instability.[37] To some extent, individuals may only feel compelled to use violence in the resolution of their own personal conflicts when they are unable to resort to a centralized and effective state which is willing and able to make use of force on their behalf (Weber et al., 2004). Hence, an otherwise law-abiding individual who feels threatened by another may see homicide as the best alternative to protect one’s life, family, and property when that individual is unable to rely on a criminal justice system. In a country where homicide perpetrators are largely unaccounted for, and impunity is the norm, the private use of violence may be both reasonable and rational, as the only accessible means to safety for large parts of a population. Many communities in the United States may have found themselves in this situation of

[37] This is yet another example of the interdependence between country-level disadvantages.

normlessness during the crack epidemic. This collapse in civil society was also likely the case in many locations throughout Eastern Europe during the 1990s, and it is certainly the current circumstance in many countries in Latin America.

Researchers can also take advantage of the relationship between age composition and homicide rates to forecast future rates of crime. To date, criminology still lacks the theoretical and methodological instrumentation to predict future rates of violence, and past attempts to do so have notably failed (Dilulio, 1995). The development of a comprehensive model for explaining changes in crime rates should, over the long term, enable improvements in the accuracy of such predictions. Any model for such purposes would need to account for the particularities of each location, and for the range of criminogenic pressures influencing rates of crimes, but age composition would likely be an important predictor. To be clear, I do not expect this forecasting to be ever without error. For example, weather forecasting, a subject of research that likely receives considerably more resources than the forecasting of crime trends, is very often mistaken about the climate, particularly when making longer-term projections (Watts, 2005). However, despite the presence of error, weather forecasting has become an essential source of information to the routine lives of individuals. I believe the same is true for the forecasting of crime trends, as an increase in accuracy would gradually improve the usefulness of this methodological instrument, regardless of the incurrence of error.

Generally, as populations worldwide continue to grow older, the world should continue to experience the repercussion of a reduction in the relative size of their youth populations. All else being constant, such demographic trends should continue to place downward pressure on crime trends. However, this aging process should also pose a range of social and economic challenges including a decrease in the number of individuals of working-age, coupled with an increase in the relative size other age-segments of the population in need of support (Kinsella & Phillips, 2005). Furthermore, the most violent countries in the world, which had the most to gain from a decrease in their homicide rates, are not participating in the international homicide decline. While these countries are experiencing an aging of their populations, they are failing to accrue the pacifying benefits of this process, resulting in even more inequality between the homicide rates of the safest, and of the most violent places of the world. While the most violent countries will continue to experience population aging, governments of these nations may not be able to experience declines in their homicide rates until they address the range of other criminogenic forces which are dictating the homicide trends of their countries.

Findings of this dissertation also hold several implications for public officials. In the current study, I provided evidence that the decline in homicides experienced by many countries since the 1990s was actually an international event, which was likely largely driven by cross-national phenomena. In many countries, policymakers often link declining homicide trends to the implementation of their own domestic policies (Bratton & Kelling, 2015). To be clear, I do not argue that crime policies are ineffective. Instead, I propose that realistic assessments of the impact of such policies must consider their impact net of the influence of macro social and economic trends that have immense repercussions for trends of crimes. A failure to take this approach may have erroneously attributed falling crime rates in the 1990s in the United States to domestic policies, when in fact such trends may have been largely linked to a broader shift in the age structure.

Furthermore, be emphasizing the strong link between the size of the youth population and homicide rates, this study also encourages the use of prevention programs focused on the youth as a strategy for addressing crime. Examples of demonstrably effective programs are numerous, including the Nurse-Family Partnership (Olds, 2006), a program for supporting early mothers and newborns in a situation of risk, and Multisystemic Therapy (Asscher et al., 2013), an intensive therapy program dedicated to empowering families and communities to decrease anti-social behavior. Comprehensive lists of programs are maintained by the CrimeSolutions.gov, and by the Blueprints for Healthy Youth Development. If properly developed and implemented, these programs have the potential to interrupt deviant trajectories, and to substantially improve people's lives (Lipsey, 2009). Perhaps even, if implemented effectively and at a large enough scale, these programs may be capable of altering the homicide trend of a country – net of the influence of macro demographic forces.

Methodological Implications

The current study holds three broader methodological implications for the study of crime trends, which may support future research. First, that the drivers of changes in crime over time may not be the same factors as those explaining differences in violence levels across places. This distinction between longitudinal and cross-sectional causes may be key in explaining differences in results in previous research, and may support parallel developments in both theory and methods to explore such differences, and to explain them.

A second implication relates to the development of the concept of *concentrated disadvantage* (Hannon, 2003; Kahlmeter et al., 2017; Raine, 2002) to the study of crime trends. In the current study, I presented evidence that the effect of age composition on homicide trends is only directly notable in the absence of other country-level disadvantages, which are competing drivers of the homicide trend. I believe that conceptualization has several important implications for extant research. First, other theoretical propositions attempting to explain crime trends may also need to account for the interaction between disadvantages when arguing for the effect of any individual variable on rates of crimes. Methodologically, that variation implies a heterogeneity in the effect of each disadvantage, across levels of concentration of all other disadvantages competing for effect. Unfortunately, that heterogeneity adds much complexity to the investigation of the causes of crime trends. As one potential solution, I propose the use of quantile regression as a parsimonious and effective way to explore variations in effect across levels of concentrated disadvantage. Specifically, by utilizing a quantile regression researchers may be able to identify the effect of one individual country-level disadvantage at the lowest end of the distribution of a dependent variable (e.g. the homicide rate, or the rate of any other crime), where competing drivers of that outcome variable are less pronounced.

Traditional regression analyses have become commonplace across the social sciences as a method for estimating average effects. These averages, however, may omit key variations in effect that could reshape some of the existing knowledge about social phenomena. In addition, I demonstrate that a strong relationship may exist between two variables, while that relationship is not observable in traditional regression analyses due to the heightened influence of other factors driving an outcome. This conclusion points to the need for caution in the direct interpretation of regression coefficients and highlights the importance of strong theoretical arguments in support of such models.

Finally, a third methodological implication is the need to account for the effect of age composition when investigating the impact of other drivers of crime trends, such as when estimating the effect of an individual policy. That point stems from the strong association between age composition and homicide trends identified in the current study. Fortunately, numerous methodological solutions exist to account for the influence of demographic composition. In particular, I highlight the use of age standardized homicide rates, which is already a common practice in the study of other causes of mortality which are closely related with age composition (Ahmad et al., 2001). For instance, an increase in prevalence of deaths by cancer in a country can simply be a consequence of an increase in the population who lived long enough to die from cancer. A study attempting to explore the effect of changes in dietary practices on the prevalence of cancer must first account for differences in age composition across countries, under the risk of confoundedness. A typical solution is to calculate age-adjusted death rates (Deane, 1987). This age adjustment artificially holds the age distribution of countries constant by decomposing an estimated effect of age from each individual observation. I argue that similar solutions should be explored in the study of crime trends, in particular given the strength of the association between age composition and homicide rates.

Final Remarks

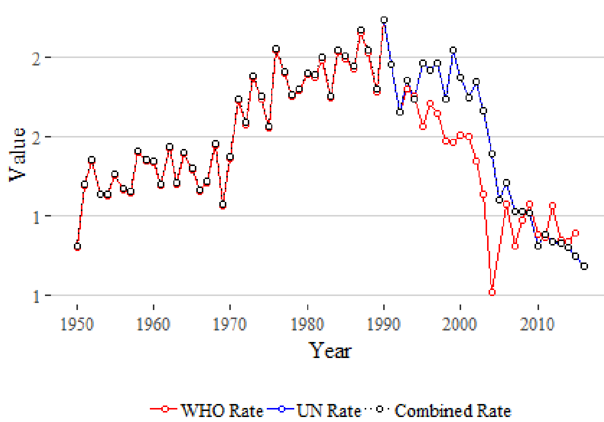
I conclude that age composition is a key driver of homicide trends globally, including the international homicide decline of recent decades. Through this conclusion, I have provided one potential answer to one of the most puzzling mysteries of criminological research over recent decades. To be clear, I say “one” answer, and not “the” answer. It is my belief that the very definition of scientific knowledge prohibits science from ever having final answers to any question (Popper, 1959), and criminological inquiry is no exception. The falsifiability of science is what distinguishes the knowledge it produces from faith, or opinion. Hence, there can always be an alternative explanation for the international homicide decline, and it is not the intent of this project to disprove all competing theories. To the contrary, causes can operate in combination, or through some complex interaction which is yet to be uncovered.

Nonetheless, the current study provides a wealth of empirical evidence and theoretical elaboration in support of its main conclusions, which I hope are meaningful and useful contributions to the understanding of crime trends.

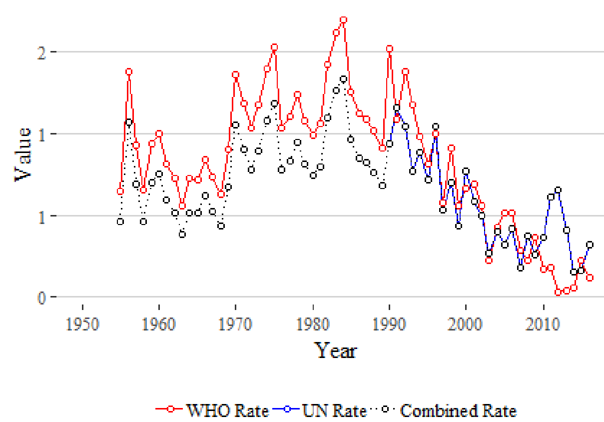
Appendices

Appendix A: Homicide Trend by Source for Countries with Combined Series

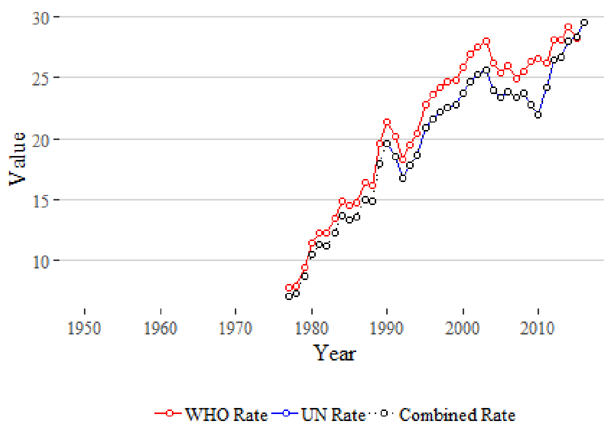
Australia: Ratio=1.005; Cor=0.623



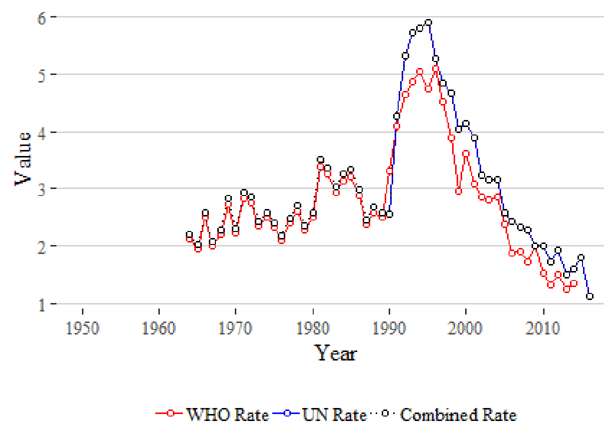
Austria: Ratio=0.832; Cor=0.764



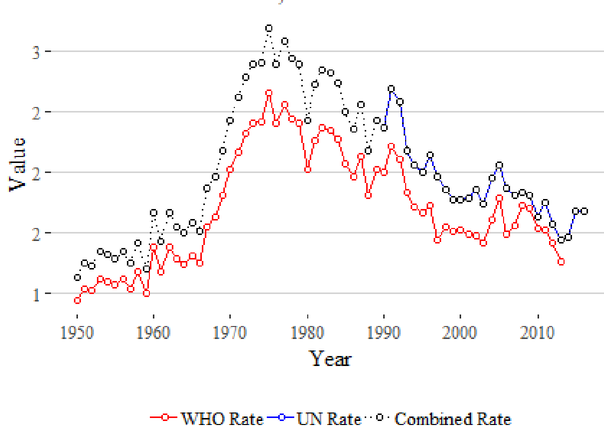
Brazil: Ratio=0.917; Cor=0.984



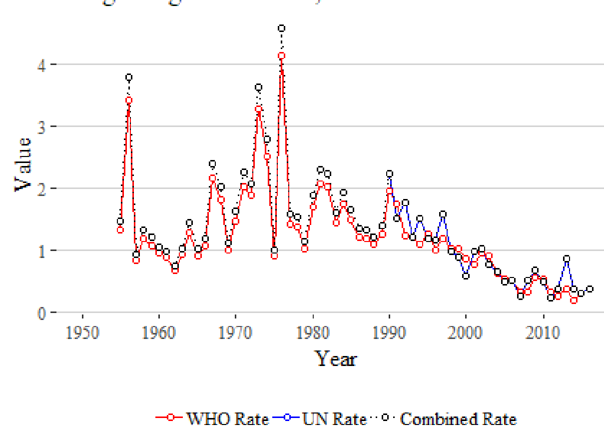
Bulgaria: Ratio=1.034; Cor=0.972

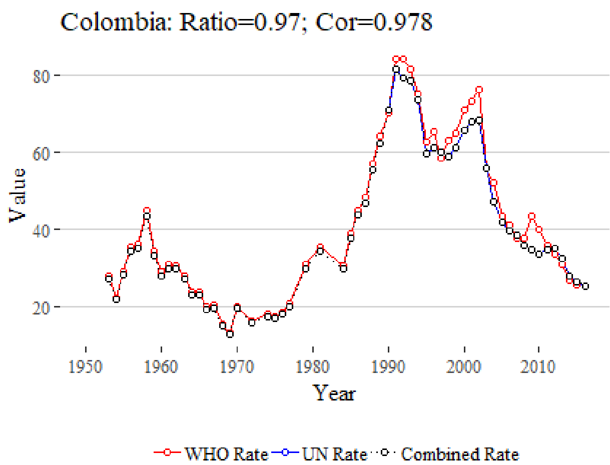


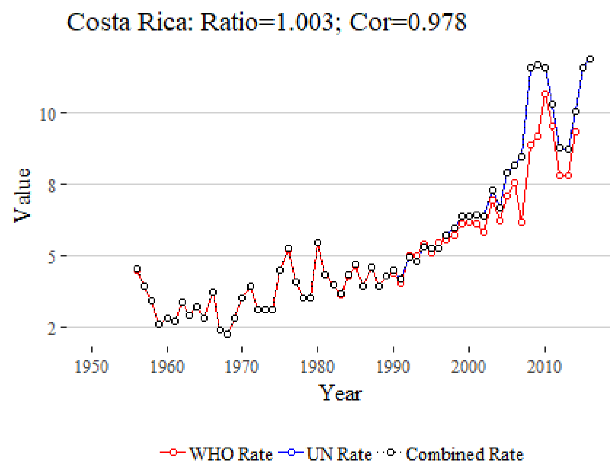
Canada: Ratio=1.204; Cor=0.84

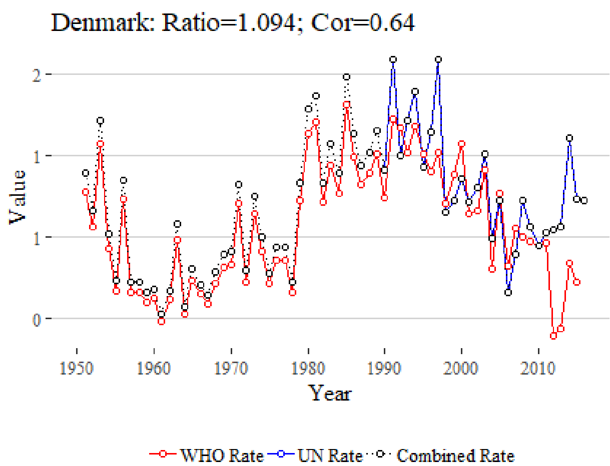


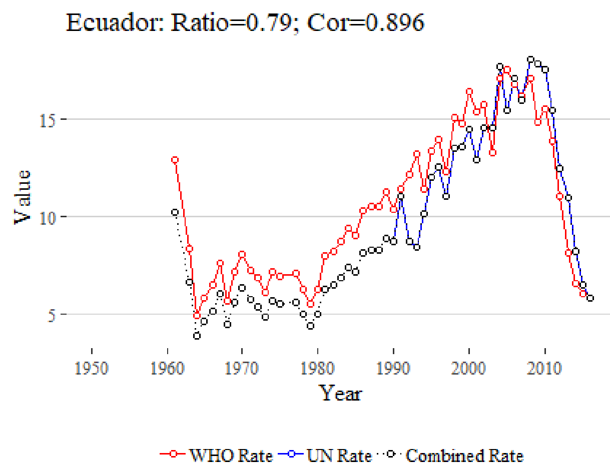
Hong Kong: Ratio=1.11; Cor=0.881

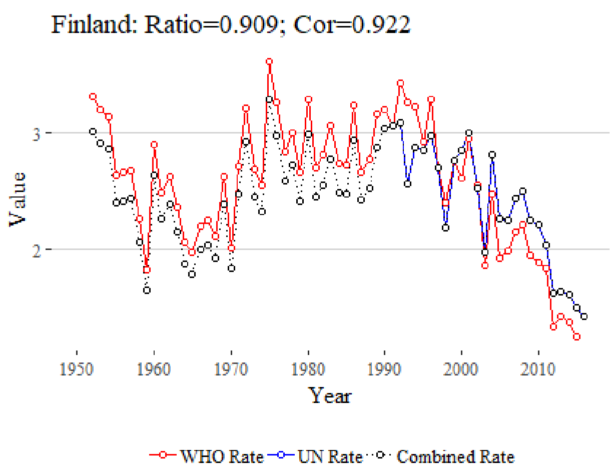


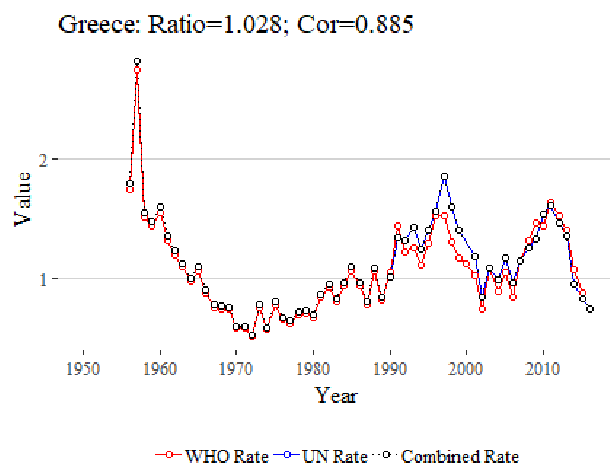

Colombia: Ratio=0.97; Cor=0.978
80
60
40
20
Value
1950 1960 1970 1980 1990 2000 2010
Year
WHO Rate UN Rate Combined Rate

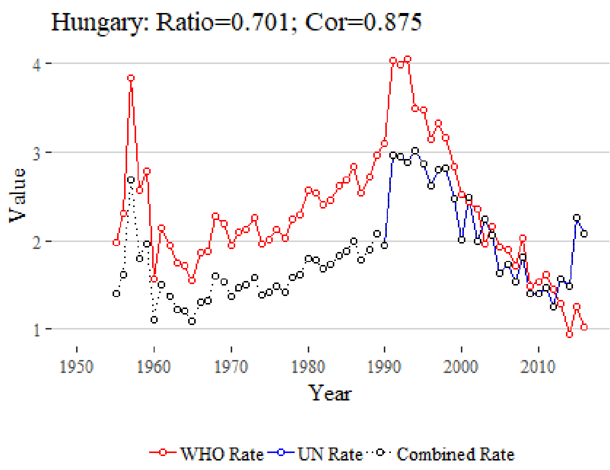

Costa Rica: Ratio=1.003; Cor=0.978
10
8
5
2
Value
1950 1960 1970 1980 1990 2000 2010
Year
WHO Rate UN Rate Combined Rate

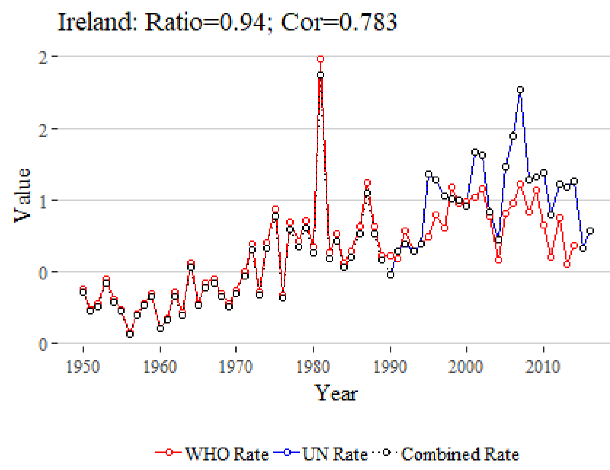

Denmark: Ratio=1.094; Cor=0.64
2
1
1
0
Value
1950 1960 1970 1980 1990 2000 2010
Year
WHO Rate UN Rate Combined Rate

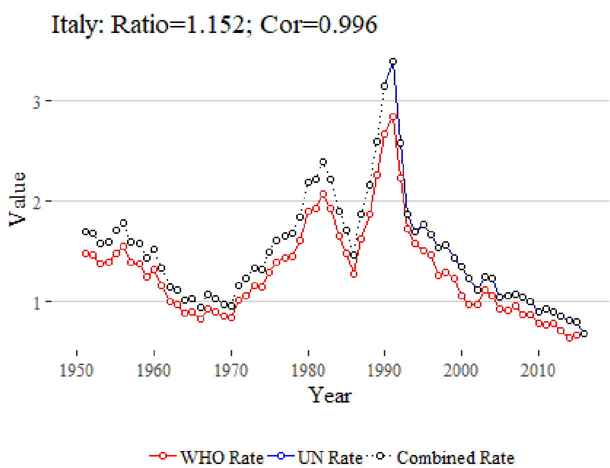

Ecuador: Ratio=0.79; Cor=0.896
15
10
5
Value
1950 1960 1970 1980 1990 2000 2010
Year
WHO Rate UN Rate Combined Rate

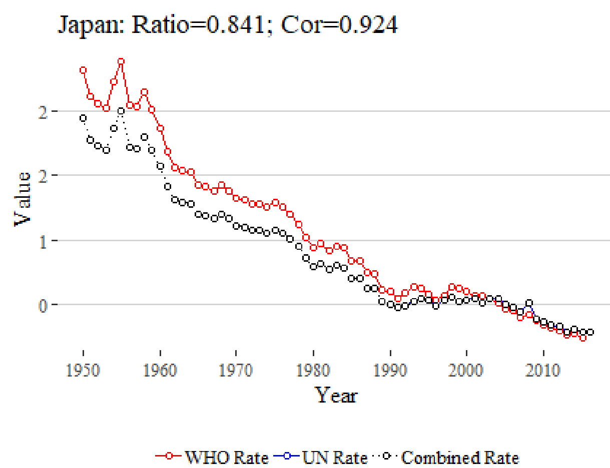

Finland: Ratio=0.909; Cor=0.922
3
2
Value
1950 1960 1970 1980 1990 2000 2010
Year
WHO Rate UN Rate Combined Rate

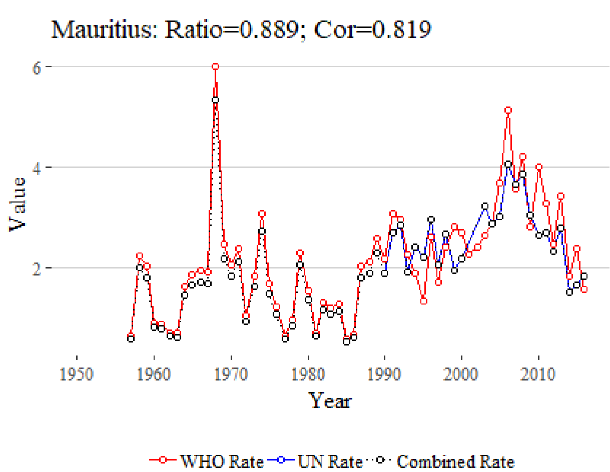

Greece: Ratio=1.028; Cor=0.885
2
1
Value
1950 1960 1970 1980 1990 2000 2010
Year
WHO Rate UN Rate Combined Rate

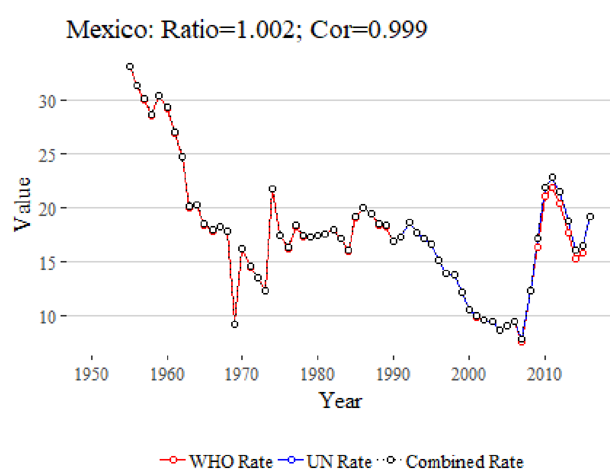

Hungary: Ratio=0.701; Cor=0.875
Value
Year
WHO Rate
UN Rate
Combined Rate


Ireland: Ratio=0.94; Cor=0.783
Value
Year
WHO Rate
UN Rate
Combined Rate

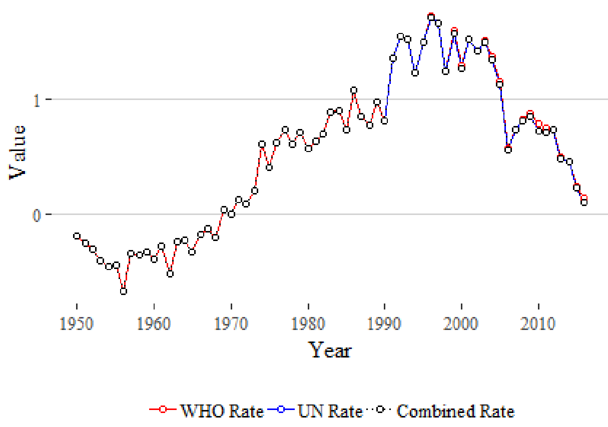

Italy: Ratio=1.152; Cor=0.996
Value
Year
WHO Rate
UN Rate
Combined Rate


Japan: Ratio=0.841; Cor=0.924
Value
Year
WHO Rate
UN Rate
Combined Rate

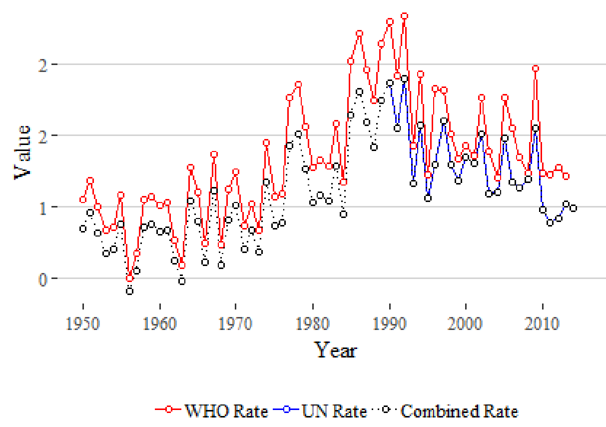

Mauritius: Ratio=0.889; Cor=0.819
Value
Year
WHO Rate
UN Rate
Combined Rate


Mexico: Ratio=1.002; Cor=0.999
Value
Year
WHO Rate
UN Rate
Combined Rate

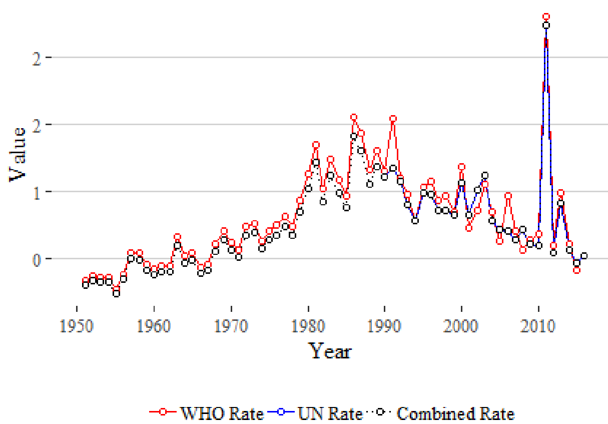
Netherlands: Ratio=1; Cor=0.999



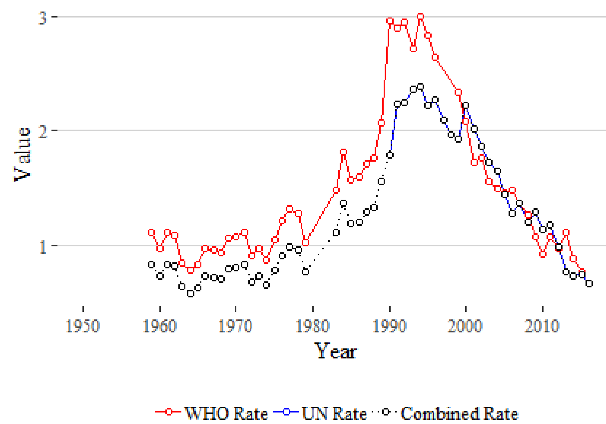
New Zealand: Ratio=0.812; Cor=0.892



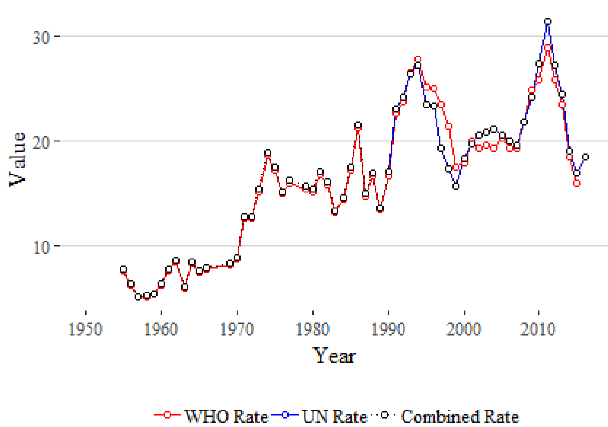
Norway: Ratio=0.906; Cor=0.959



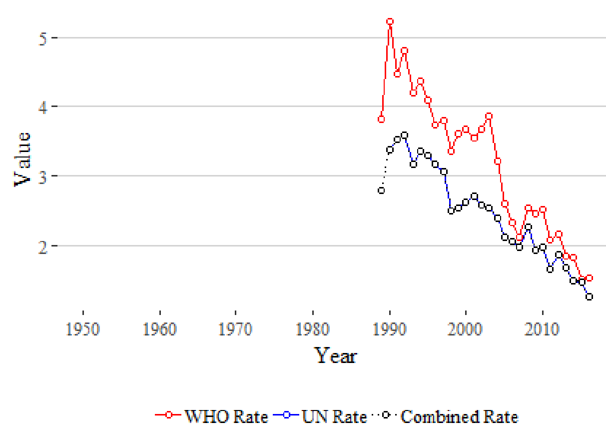
Poland: Ratio=0.753; Cor=0.901

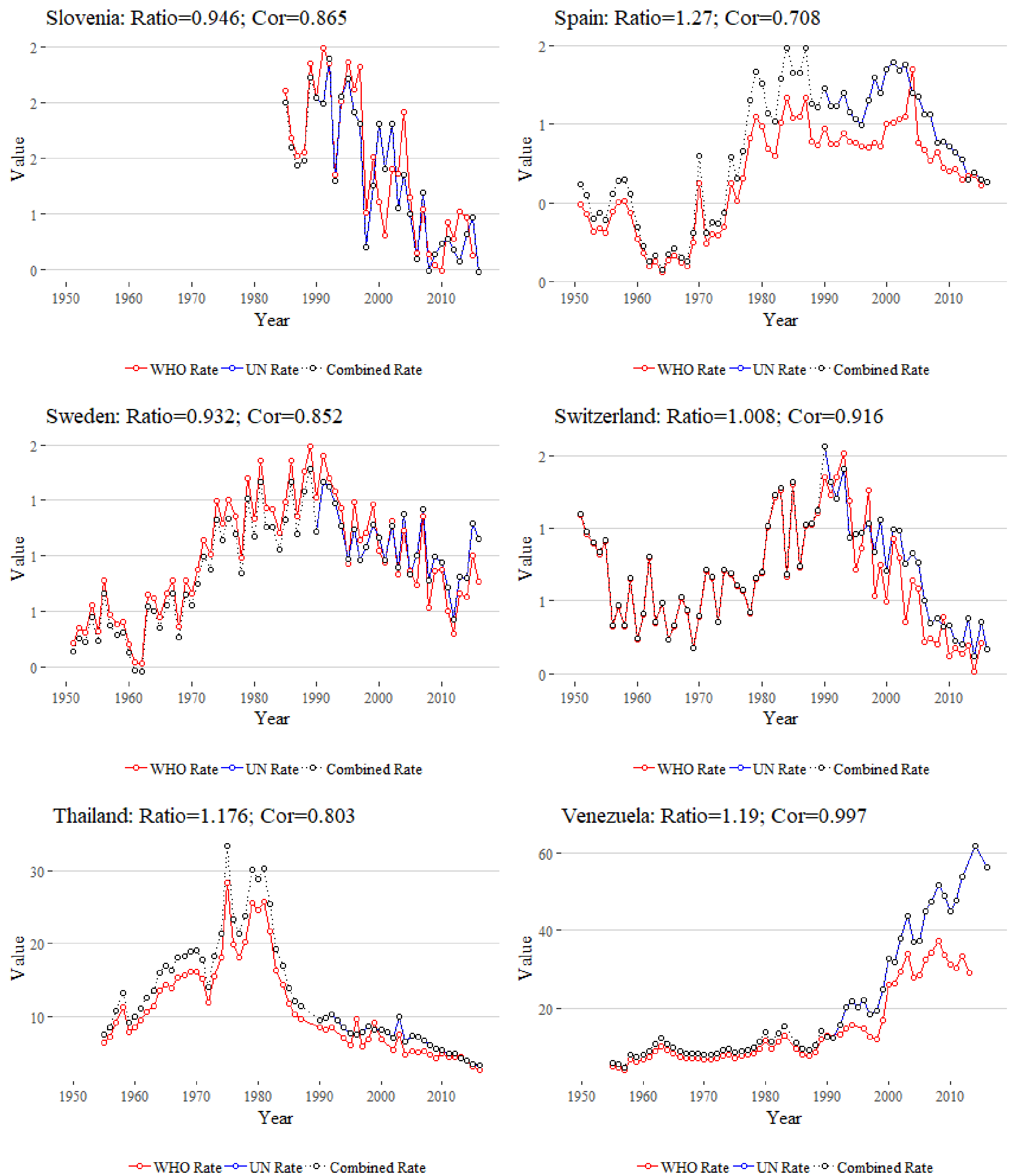


Puerto Rico: Ratio=1.014; Cor=0.905



Romania: Ratio=0.733; Cor=0.972





Note: The Ratio corresponds to four-year average between the WHO homicide rate and the UN homicide rate between 1990 and 1993. The correlation corresponds to the Pearson Correlation between the both rates over all overlapping years in the two series'.

Appendix B: List of Countries in each Analytical Samples with Summary Statistics

Region	Country	Total Years	Years		Homicide Rate			
			First	Last	Mean	SD	Min	Max
Long Series Sample (Since 1960)								
Africa	Mauritius	58	1957	2016	1.97	0.99	0.53	5.34
Asia	Hong Kong	62	1955	2016	1.36	0.85	0.24	4.58
	Japan	67	1950	2016	0.91	0.49	0.28	2.00
	Thailand	60	1955	2016	12.85	7.38	3.24	33.45
Eastern Europe	Hungary	62	1955	2016	1.83	0.52	1.09	3.02
	Poland	55	1959	2016	1.25	0.56	0.58	2.39
Latin America	Colombia	58	1953	2016	39.65	18.75	13.03	81.41
	Costa Rica	61	1956	2016	5.40	2.66	2.24	11.90
	Mexico	62	1955	2016	17.83	5.78	7.93	33.14
	Puerto Rico	59	1955	2016	16.47	6.55	5.12	31.40
	Venezuela	59	1955	2016	20.13	15.95	4.56	61.91
Northern America	Canada	67	1950	2016	2.02	0.56	1.13	3.19
	United States	67	1950	2016	6.55	1.92	4.08	9.89
Oceania	Australia	67	1950	2016	1.60	0.34	0.94	2.19
	New Zealand	65	1950	2014	1.10	0.35	0.41	1.90
Western Europe	Austria	62	1955	2016	0.95	0.23	0.52	1.47
	Denmark	66	1951	2016	0.96	0.32	0.43	1.67
	Finland	65	1952	2016	2.44	0.45	1.42	3.29
	Greece	60	1956	2016	1.11	0.40	0.53	2.81
	Ireland	67	1950	2016	0.70	0.40	0.07	1.87
	Italy	66	1951	2016	1.49	0.55	0.67	3.39
	Netherlands	67	1950	2016	0.76	0.33	0.17	1.36
	Norway	66	1951	2016	0.74	0.34	0.24	2.24
	Spain	66	1951	2016	0.83	0.41	0.08	1.49
	Sweden	66	1951	2016	0.96	0.23	0.48	1.39
	Switzerland	66	1951	2016	0.96	0.28	0.50	1.65
High Coverage Sample (Since 1990; includes the above)								
Africa	Algeria	13	2003	2015	1.10	0.41	0.61	2.01
	Angola	2	2011	2012	4.60	0.35	4.36	4.85
	Botswana	10	2001	2010	14.61	1.31	12.14	17.29
	Burkina Faso	14	2002	2015	0.59	0.12	0.37	0.78
	Burundi	9	2008	2016	4.82	0.81	3.86	6.02
	Cameroon	9	2000	2012	4.91	1.22	3.01	6.57
	Central African Rep	1	2016	2016	19.76		19.76	19.76
	Egypt	15	1990	2012	1.04	0.87	0.37	3.15
	Ghana	11	2001	2011	1.91	0.19	1.68	2.23
	Kenya	13	2004	2016	4.29	1.03	2.89	5.47
	Lesotho	13	1990	2015	37.31	5.24	30.67	48.09
	Liberia	6	2007	2012	3.66	0.70	2.85	4.83
	Malawi	13	2000	2012	3.99	1.99	1.53	7.70
	Morocco	24	1990	2015	1.35	0.54	0.36	2.63
	Mozambique	11	2001	2011	4.57	0.93	3.40	5.92
	Namibia	14	1995	2012	18.47	2.59	13.90	22.53
	Niger	2	2011	2012	4.66	0.30	4.44	4.87
	Rwanda	8	2006	2015	2.82	0.72	1.48	3.77
	Sierra Leone	10	2004	2015	2.20	0.49	1.67	2.98
	South Africa	23	1994	2016	42.38	11.03	29.76	63.86
	South Sudan	1	2012	2012	13.90		13.90	13.90
	Sudan	2	2007	2008	4.92	0.34	4.68	5.16
	Swaziland	15	1990	2010	16.13	2.82	10.80	19.20

Region	Country	Total Years	Years		Homicide Rate			
			First	Last	Mean	SD	Min	Max
	Tanzania	11	1995	2015	7.66	0.58	6.95	8.72
	Tunisia	8	2004	2012	2.56	0.31	1.95	3.05
	Uganda	15	1995	2014	9.28	1.19	7.43	11.52
	Zambia	16	1990	2015	7.16	1.70	5.28	10.47
	Zimbabwe	9	1990	2012	9.20	2.89	5.05	12.98
Asia	Afghanistan	4	2009	2012	4.47	1.29	3.41	6.35
	Armenia	27	1990	2016	3.42	1.68	1.95	8.86
	Azerbaijan	24	1990	2016	3.48	1.66	2.14	7.55
	Bahrain	17	1995	2014	0.75	0.34	0.31	1.38
	Bangladesh	16	2000	2015	2.66	0.13	2.50	2.87
	Cambodia	20	1992	2011	3.70	1.29	1.84	6.84
	China	22	1995	2016	1.46	0.58	0.62	2.21
	Cyprus	27	1990	2016	1.00	0.47	0.13	1.95
	Georgia	23	1990	2016	6.86	3.48	0.99	16.87
	India	27	1990	2016	4.50	0.88	3.22	6.15
	Indonesia	14	1998	2016	0.65	0.19	0.44	1.04
	Iran	5	2003	2014	2.72	0.22	2.47	3.01
	Iraq	11	1990	2013	8.42	2.72	5.88	15.79
	Israel	25	1990	2015	2.44	0.62	1.36	3.64
	Jordan	20	1990	2016	2.08	1.05	0.77	4.48
	Kazakhstan	23	1990	2015	11.92	3.87	4.81	16.59
	Kuwait	13	1996	2012	1.70	0.39	0.98	2.36
	Kyrgyzstan	27	1990	2016	8.90	3.31	3.62	19.77
	Lebanon	9	2008	2016	4.00	0.35	3.47	4.47
	Malaysia	24	1990	2013	2.15	0.28	1.68	2.84
	Mongolia	14	2003	2016	9.68	3.23	5.66	15.75
	Myanmar	19	1990	2016	2.18	0.89	1.39	5.04
	Nepal	20	1990	2016	2.79	0.55	1.89	3.70
	Oman	13	2002	2014	1.74	1.01	0.66	4.68
	Pakistan	22	1990	2016	6.86	0.89	4.41	7.96
	Palestine	17	1995	2016	1.50	1.03	0.54	4.38
	Philippines	24	1990	2016	9.18	2.25	6.41	14.98
	Qatar	20	1990	2014	0.60	0.28	0.17	1.21
	Saudi Arabia	10	1999	2015	1.13	0.20	0.83	1.50
	Singapore	27	1990	2016	0.77	0.49	0.21	1.76
	South Korea	27	1990	2016	0.74	0.16	0.48	1.08
	Sri Lanka	18	1990	2016	6.53	3.27	2.35	11.45
	Syrian Arab Rep	14	1997	2010	2.28	0.20	1.95	2.71
	Taiwan	9	2001	2015	0.87	0.21	0.72	1.39
	Tajikistan	22	1990	2011	5.40	5.08	1.30	23.31
	Timor-Leste	8	2004	2015	3.87	1.11	2.31	5.82
	Turkey	10	2003	2012	4.58	0.38	4.17	5.18
	Turkmenistan	17	1990	2006	6.61	1.59	4.22	9.01
	United Arab Emirates	11	2003	2016	0.81	0.22	0.59	1.22
	Uzbekistan	19	1990	2008	4.33	0.83	2.99	5.50
	Viet Nam	11	2001	2011	1.33	0.11	1.23	1.52
	Yemen	14	1998	2013	4.62	1.11	3.23	6.66
Eastern Europe	Belarus	25	1990	2014	7.22	2.48	3.51	10.33
	Bulgaria	53	1964	2016	2.99	1.14	1.14	5.90
	Czechia	23	1994	2016	1.28	0.40	0.61	2.00
	Moldova	25	1990	2014	7.62	2.06	3.19	11.40
	Romania	28	1989	2016	2.46	0.68	1.25	3.59
	Russia	24	1990	2016	21.97	7.25	10.82	32.25
	Slovakia	26	1990	2016	1.90	0.55	0.81	2.61

Region	Country	Total Years	Years		Homicide Rate			
			First	Last	Mean	SD	Min	Max
	Ukraine	23	1990	2014	7.15	1.73	4.34	10.03
Latin America	Argentina	3	2014	2016	6.66	0.79	5.94	7.51
	Bolivia	12	2005	2016	8.59	2.64	5.19	12.83
	Brazil	40	1977	2016	19.60	6.17	7.07	29.53
	Chile	13	2003	2016	3.39	0.36	2.51	3.74
	Cuba	25	1992	2016	5.85	1.03	4.46	8.30
	Dominican Rep	25	1991	2016	17.77	5.40	10.81	25.92
	Ecuador	54	1961	2016	9.52	4.28	3.94	18.04
	El Salvador	23	1994	2016	75.91	29.32	40.20	142.16
	Guatemala	25	1992	2016	33.97	6.26	23.32	45.39
	Haiti	10	2007	2016	8.08	2.07	5.09	10.04
	Honduras	24	1990	2016	49.13	21.05	10.00	85.06
	Jamaica	27	1990	2016	40.11	11.35	22.44	60.99
	Nicaragua	27	1990	2016	12.91	2.85	7.37	19.07
	Panama	27	1990	2016	11.69	2.62	6.52	17.27
	Paraguay	16	2000	2015	15.02	5.59	8.82	24.91
	Peru	6	2011	2016	6.68	0.75	5.43	7.67
	Trinidad & Tobago	16	2000	2015	26.38	9.37	9.46	41.59
	Uruguay	25	1990	2016	6.66	0.80	5.71	8.54
Oceania	Papua New Guinea	5	1998	2007	8.68	0.74	7.85	9.49
Western Europe	Albania	25	1992	2016	7.41	8.63	2.26	43.13
	Belgium	24	1990	2015	1.81	0.53	1.02	3.08
	Bosnia & Herzegovina	17	1990	2016	1.76	0.37	1.28	2.63
	Croatia	27	1990	2016	2.44	2.01	0.85	9.18
	Estonia	26	1990	2015	9.46	4.87	3.11	20.73
	France	27	1990	2016	1.73	0.42	1.22	2.63
	Germany	27	1990	2016	1.19	0.30	0.81	1.74
	Kosovo	9	2008	2016	3.64	1.85	1.60	6.47
	Latvia	24	1992	2015	7.54	3.67	2.45	14.98
	Lithuania	27	1990	2016	8.67	2.39	4.87	13.84
	Macedonia	17	1998	2014	2.08	0.59	1.06	3.41
	Portugal	27	1990	2016	1.22	0.24	0.64	1.74
	Serbia	17	2000	2016	1.70	0.39	1.17	2.58
	Slovenia	32	1985	2016	1.34	0.59	0.48	2.39
	United Kingdom	27	1990	2016	1.36	0.25	0.91	1.87

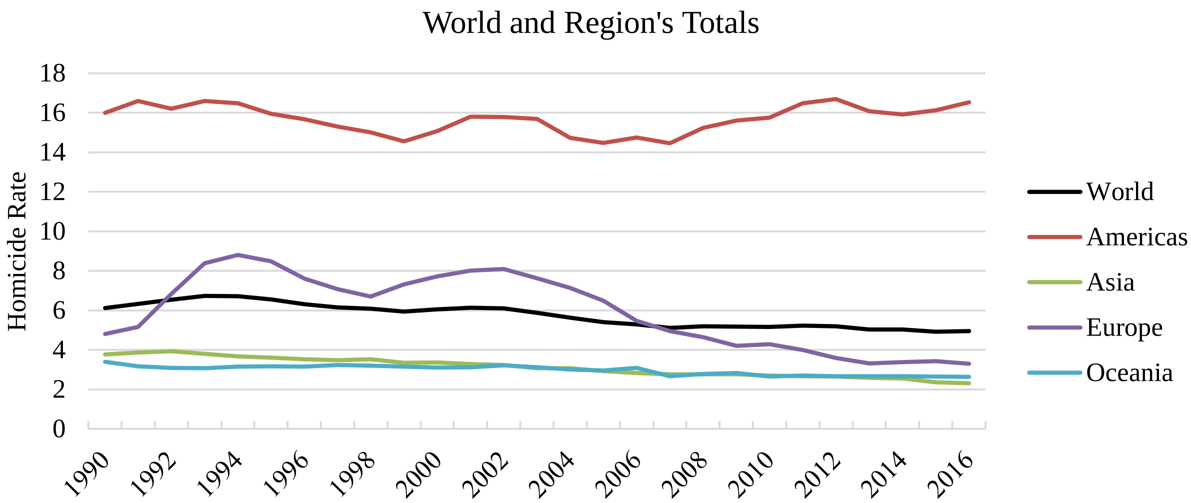
Note: All countries in the Long Series Sample are also included in the High Coverage Sample

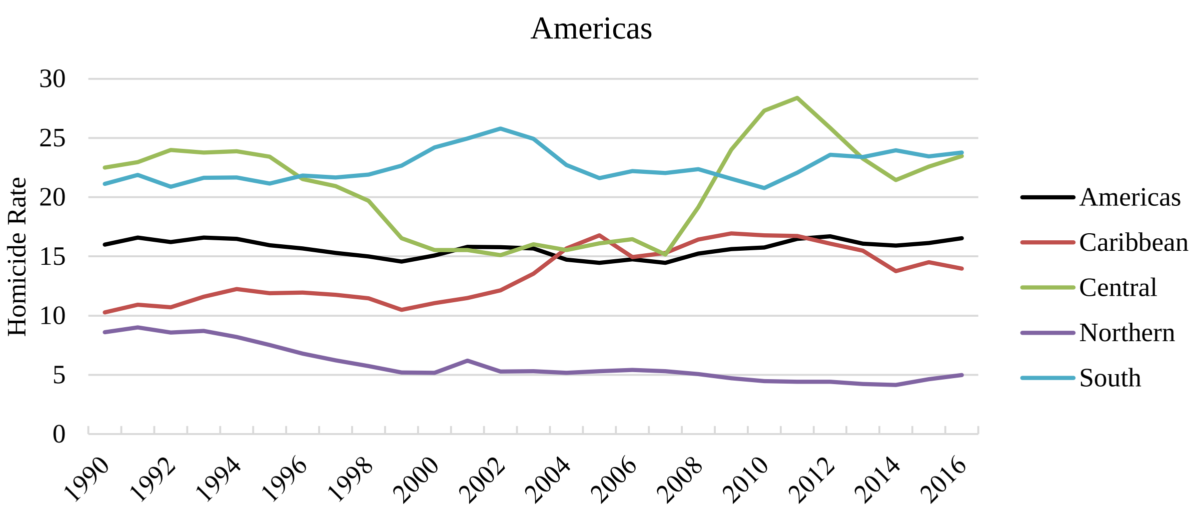
Appendix C: List of Countries Absent from the Analytical Samples

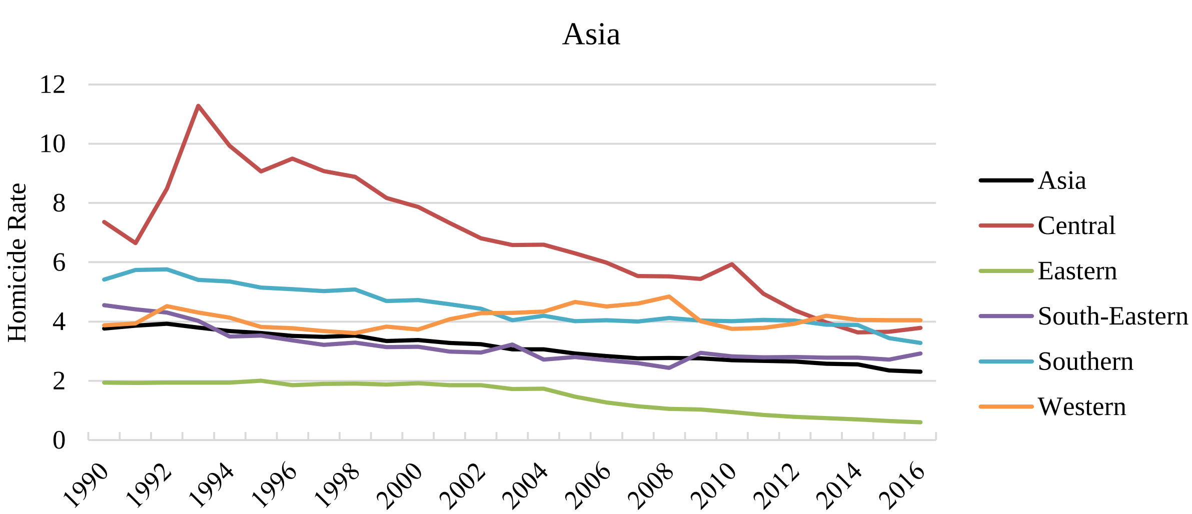
Region	Country	Total Years	Years		Homicide Rate			
			First	Last	Mean	SD	Min	Max
Small States (bellow 1 million population)								
Africa	Cabo Verde	14	2003	2016	8.34	2.66	3.26	12.35
	Mayotte	3	2007	2009	7.56	6.00	2.55	14.20
	Réunion	6	2004	2009	2.58	0.52	1.82	3.16
	Sao Tome & Principe	11	1990	2011	5.39	2.60	2.45	10.10
	Seychelles	12	2004	2016	11.72	4.76	4.33	19.40
	St Helena	16	1994	2009	1.42	5.67	0.00	22.69
Asia	Bhutan	26	1990	2016	2.65	1.09	0.80	5.08
	Brunei Darussalam	16	1996	2013	0.99	0.77	0.25	2.95
	Macao	26	1991	2016	2.26	2.37	0.00	8.84
	Maldives	13	1990	2013	1.52	0.78	0.45	2.72
Latin America	Anguilla	25	1990	2014	9.89	11.77	0.00	38.75
	Antigua & Barbuda	20	1990	2012	7.59	5.14	1.29	18.60
	Aruba	17	1990	2014	3.87	1.85	0.00	7.47
	Bahamas	25	1990	2016	21.27	7.55	10.72	37.74
	Barbados	24	1990	2015	9.07	1.80	6.42	13.06
	Belize	17	2000	2016	31.82	6.31	16.58	43.06
	British Virgin Isl	13	1990	2006	5.93	5.37	0.00	17.75
	Cayman Isl	23	1990	2014	6.49	4.00	0.00	16.21
	Curaçao	7	2001	2007	22.35	9.90	7.68	33.59
	Dominica	14	1998	2011	10.61	5.12	1.44	21.00
	French Guiana	6	2004	2009	18.67	6.54	12.92	29.58
	Grenada	17	2000	2016	9.40	3.56	3.81	15.39
	Guadeloupe	6	2004	2009	6.38	1.07	5.23	8.01
	Guyana	27	1990	2016	16.84	4.36	10.09	27.80
	Martinique	6	2004	2009	4.70	1.12	2.78	5.79
	Montserrat	19	1990	2012	7.09	9.03	0.00	20.93
	St Kitts & Nevis	18	1995	2012	25.71	16.89	6.61	65.38
	St Lucia	25	1990	2014	16.83	7.39	5.57	26.46
	St Vincent & the Grenadines	24	1990	2016	19.30	7.20	8.33	36.68
	Suriname	9	2000	2008	11.96	2.75	8.35	16.54
	Turks & Caicos Islands	20	1990	2014	5.06	4.71	0.00	13.70
	Virgin Islands (US)	16	1997	2012	35.76	9.84	21.15	52.76
Northern America	Bermuda	26	1990	2016	5.47	3.71	0.00	12.96
	Greenland	25	1992	2016	15.12	6.88	1.77	30.18
	St Pierre & Miquelon	4	2006	2009	7.97	9.20	0.00	15.95
Oceania	American Samoa	16	2001	2016	6.13	2.87	1.72	11.92
	Cook Islands	1	2012	2012	3.49		3.49	3.49
	Fiji	20	1990	2014	2.69	0.80	1.64	4.57
	French Polynesia	4	2006	2009	1.91	1.39	0.38	3.42
	Guam	12	2000	2011	3.21	2.17	0.63	6.93
	Kiribati	16	1991	2012	2.47	3.39	0.00	10.51
	Marshall Islands	3	1991	1994	6.11	3.64	3.95	10.31
	New Caledonia	4	2006	2009	4.03	0.86	3.23	5.00
	Samoa	3	2009	2013	6.80	3.16	3.15	8.66
	Solomon Islands	5	2004	2008	4.74	0.71	3.77	5.53
	Tonga	16	1995	2012	3.48	2.49	0.95	7.87
	Tuvalu	11	2002	2012	3.41	6.31	0.00	18.65
Western Europe	Andorra	10	2004	2015	0.37	0.60	0.00	1.31
	Channel Islands	4	2005	2010	0.64	0.53	0.00	1.29
	Gibraltar	2	2009	2010	1.51	2.13	0.00	3.01
	Holy See	7	2009	2015	0.00	0.00	0.00	0.00

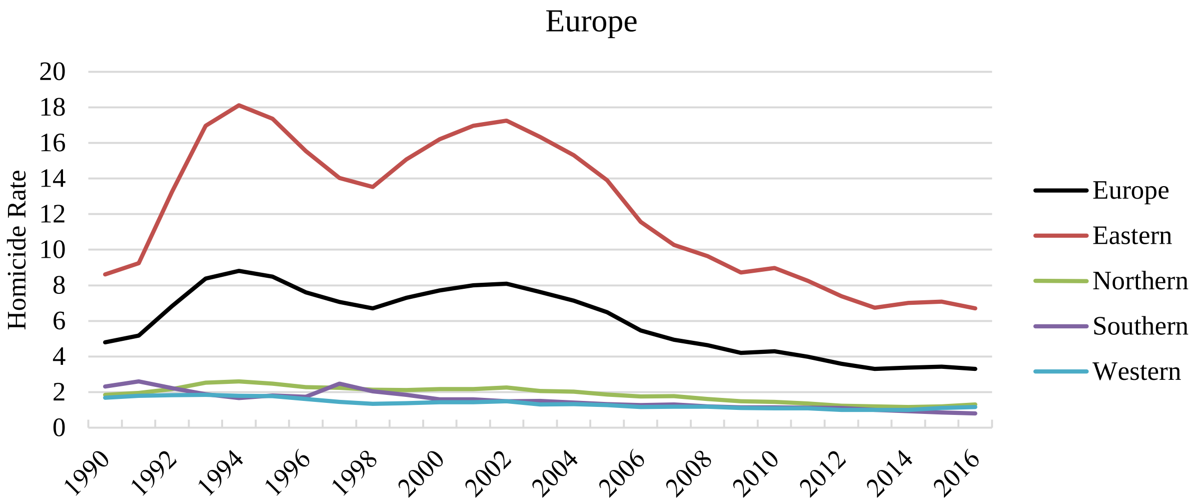
Region	Country	Total Years	Years		Homicide Rate			
			First	Last	Mean	SD	Min	Max
	Iceland	23	1994	2016	0.54	0.48	0.00	1.78
	Isle of Man	6	2011	2016	1.83	1.27	0.00	3.63
	Liechtenstein	23	1994	2016	0.62	1.20	0.00	3.04
	Luxembourg	21	1994	2014	1.04	0.54	0.00	2.04
	Malta	23	1990	2015	1.25	0.66	0.00	2.85
	Monaco	12	2001	2015	1.00	1.47	0.00	3.09
	Montenegro	15	2002	2016	3.14	0.86	1.59	4.46
	San Marino	17	1995	2011	0.21	0.86	0.00	3.56
Countries without homicide data								
Africa	Benin	0						
	Chad	0						
	Comoros	0						
	Congo	0						
	Côte d'Ivoire	0						
	Djibouti	0						
	DR Congo	0						
	Equatorial Guinea	0						
	Eritrea	0						
	Ethiopia	0						
	Gabon	0						
	Gambia	0						
	Guinea	0						
	Guinea-Bissau	0						
	Libya	0						
	Madagascar	0						
	Mali	0						
	Mauritania	0						
	Nigeria	0						
	Senegal	0						
	Somalia	0						
	Togo	0						
	Western Sahara	0						
Asia	Lao	0						
	North Korea	0						
Latin America	Caribbean Netherlands	0						
	Falkland Islands	0						
	Sint Maarten (Dutch)	0						
Oceania	Micronesia	0						
	Nauru	0						
	Niue	0						
	Northern Mariana Islands	0						
	Palau	0						
	Tokelau	0						
	Vanuatu	0						
	Wallis & Futuna Islands	0						
Western Europe	Faroe Islands	0						

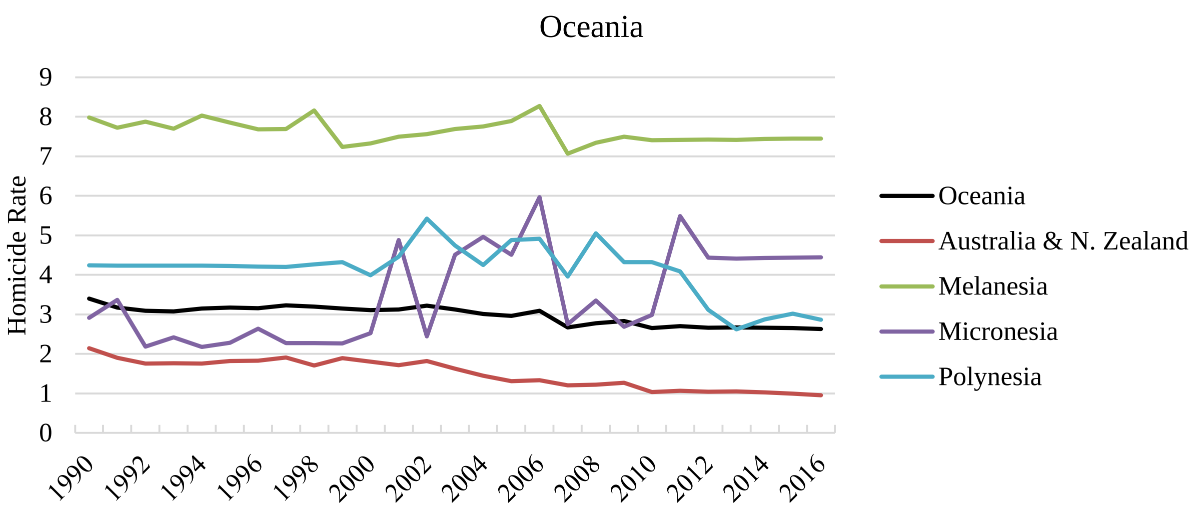
Appendix D: Homicide Trends by Region and Subregion per the Original UN M49 Classification








Europe
Homicide Rate
20
18
16
14
12
10
8
6
4
2
0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Europe
Eastern
Northern
Southern
Western


Oceania
Homicide Rate
9
8
7
6
5
4
3
2
1
0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Oceania
Australia & N. Zealand
Melanesia
Micronesia
Polynesia

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